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DECLINING NAVY BUDGETS
ON
UNITED STATES SHIPYARDS

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THE IMPACT OF DECLINING NAVY BUDGETS ON UNITED STATES SHIPYARDS

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ABSTRACT

U.S. shipyards are an integral component of the nation's defense infrastructure. Shipyards provide shipbuilding capability and repair support for the U.S. Navy and the U.S.-flag fleet. During the 1980s, however, U.S. Navy shipbuilding, repair, and modernization programs achieved dominance over commercial vessel shipyard work. Commercial business at U.S. shipyards declined to a point where by 1991 Navy work accounted for ninety percent of the direct labor hours at the biggest five shipyards within the United States. With the end of the Cold War and the downsizing of the armed forces, U.S. shipyards now face years of declining Navy budgets. This thesis addresses the shipbuilding industry, the factors contributing to the decline in commercial shipbuilding orders, the growth of Navy shipbuilding work, and proposes avenues whereby U.S. shipyards can regain a competitive foothold in the international commercial shipbuilding market.

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I. INTRODUCTION

A. PURPOSE

The main purpose of this thesis is to examine the impact of the declining Navy shipbuilding budget on the public and the private shipyards within the United States. Specific areas to be addressed include: labor force levels, supplier base impact, national defense concerns, and foreign competition. In addition, this thesis will focus on alternative measures which can be taken to facilitate the transition from the recent emphasis on Navy shipbuilding to an emphasis on commercial shipbuilding with a primary goal being the development of U.S. shipyards into world class competitors for new ship builds and repair.

B. SCOPE

With the exception of World War I and World War II, the United States has not been a dominant force in the international shipbuilding industry during the last 150 years. The era of the Clipper ship (1830 - 1890) is the one exception in time where U.S. commercial shipbuilders were a dominant player in the international merchant shipbuilding market. Since the two world wars, however, American shipyards, at best, were only able to attract and keep a level of business that equalled single digit percentages of the world

shipbuilding market. Since the conclusion of World War II, the United States shipbuilding industry has steadily been losing this single digit world share to foreign shipyards. As American shipyards have been unable to maintain a profitable level of new build and repair business, the number of U.S. shipyards has been declining.

The 1980s witnessed a dramatic decline in world shipbuilding demand. Despite this industry-wide depression, U.S. shipyards were protected from global economic forces by the Reagan defense buildup. However, now the 1980's goal of a 600 ship Navy has been adjusted down to a force of about 400 active ships. The amount of shipbuilding and repair work available to U.S. shipyards under this downsized Navy will not be enough to support the existing U.S. shipyard base. A further decline in shipyard capacity and capability raises issues concerning the ability of the United States to maintain its industrial base as well as its ability to mobilize its industrial base for war.

This thesis will cover some of the factors that have led to the current situation by examining the shipbuilding industry, the present economic and political environment facing the shipyards, and some of the recommendations from various interest groups who claim that their recommendations will enable the shipyards to become world-class competitors capable of attracting the level of new builds and repairs

required to stay in business without an over reliance on naval construction or naval repair.

C. METHODOLOGY

The methodology used in the development of this thesis includes the study of published and unpublished information from various sources including general literature, government commissions, government agencies, and past Naval Postgraduate School theses. Relevant information from these sources was compiled in an effort to obtain a complete understanding of the subject from which a comprehensive analysis could be done. Whenever possible the most current information available was incorporated into this thesis.

D. ORGANIZATION

This thesis is divided into five chapters. Chapter I provides an introduction and background data for the thesis. Chapter II provides an overview of the shipbuilding industry. Chapter III analyzes the causes for the decline in U.S. shipyards. Chapter IV summarizes current proposals to reverse the decline, and Chapter V presents conclusions and recommendations based on the facts presented throughout the thesis.

E. BACKGROUND

The United States shipbuilding industry has not been competitive with foreign shipyards since the end of the Second

World War. As a result of this inability to compete on the world shipbuilding market, commercial shipbuilding in the United States has virtually ground to a halt. If it were not for the defense buildup years under President Reagan, U.S. shipyards would have faced the full brunt of the world-wide shipbuilding depression of the 1980s.

During the 1980s a significant amount of work was contracted for by the U.S. Navy. In fact, so much Navy work was ordered that the vast majority of new builds in U.S. yards were for naval vessels. Navy funding dominated the industry to the point where approximately 97 percent of all direct ship labor hours could be attributable to Navy contracts [Ref. 1: p. 3]. This boom in naval construction, however, is rapidly coming to a close due to the end of the "Cold War" between the United States and the former Soviet Union and due to the mounting budgetary problems of the U.S. government. The Navy's fiscal year (FY) 1992 through 1997 shipbuilding and repair programs reflect significantly lower levels of work than those of previous years. During the 1980s, the Navy's construction programs averaged nineteen new ships per year, whereas the current FY 92 through 97 budget request reflects new construction at a rate of less than ten ships per year or approximately 50 percent of the average workload experienced during the 1980s [Ref 1:p. 2].

Adding to U.S. shipyard woes are the declining number of repair and modernization availabilities. The number of repair

availabilities is shrinking for two reasons. First, significant gains in maintainability and reliability have been achieved since the advent of the Navy's Reliability Improvement Program. This program is designed to reduce the life cycle cost of Navy systems by improving mean time between failures and reducing preventive and corrective maintenance time. Second, as the Navy decommissions more and more ships, the demand for repair and modernization availabilities will decline. Due to these fundamental changes in the industry's environment, dramatic repercussions are expected in both the U.S. shipbuilding industry and in the shipbuilding support industry.

The Navy contracts of the 1980s supported about ninety percent of the labor force at the five primary, private shipyards performing Navy work. The big five shipyards benefiting most from the Navy build-up included: Avondale, Bath Iron Works, General Dynamics/Electric Boat Division, Ingalls, and Newport News Shipbuilding [Ref. 1:p. 2].

The magnitude of the proposed decline in Navy construction and repair programs, combined with the lack of commercial shipbuilding contracts, are a cause for alarm. Current commercial and military construction and repair contracts will not support the shipbuilding capacity present in the U.S. today. Based on the projected reduction in Navy business, twenty-five to thirty-five merchant ship builds per year will

be required in order to maintain the current industrial base level [Ref. 2:p. 3].

Consequently, unless demand for American-built ships increases, shipyard capacity will continue to shrink. This anticipated loss of further shipbuilding capacity raises serious national issues in the areas of: mobilization requirements to meet national defense needs; the impact on the shipyard supplier base; the impact on the remaining shipyards in terms of labor pools, facilities, and the capability to continue to develop naval technological improvements; and the risks of relying on foreign shipbuilding capability to meet the needs of the American economy.

II. SHIPBUILDING OVERVIEW

Chapter II will provide an overview of the shipbuilding industry. First, historical background material on shipbuilding in the United States will be presented. Second, an overview of the world's shipbuilding industry will be described. The chapter will conclude with the recent declines being experienced by U.S. yards.

A. HISTORICAL PERSPECTIVE

The shipbuilding industry in North America dates back to the colonial days. Small warships were built by the English and the Dutch using temporary government dockyards and shipwrights brought into the colonies for specific ship builds. At the end of construction, the shipwrights were usually sent home. This policy helped prevent the development of a large shipbuilding industry or a naval construction program in the colonies [Ref. 3:p. 5].

American naval shipbuilding is said to have started with the construction of the *FALKLAND*, a British naval man-of-war, in Portsmouth, New Hampshire in 1690. This warship was contract-built by a private shipyard. Also, for the first time, colonial rather than foreign shipwrights were used [Ref. 3:p. 5].

Although the colonies obtained further shipbuilding experience in the years that followed, they were ill prepared for the Revolutionary War with England, at that point in time the strongest naval power in the world. In 1775, the Continental Congress purchased two merchant ships of about 450 tons and outfitted them with 24-guns each. The government later obtained six brigs or brigantines, three schooners and five sloops to defend America's coasts from the British. By December of that year, thirteen more frigates were ordered constructed by the Continental Congress followed by an additional ship order in November 1776 for three 74-gun ships, five 36-gun frigates, an 18-gun brig, and a packet. Additional ships were purchased, borrowed, or captured throughout the war until its conclusion [Ref. 3:pp. 53-79].

These early ships were made primary from oak wood. Oak, however, was later replaced by teak towards the end of the eighteenth century. Although wood requirements varied from ship type to ship type, a typical vessel of this period took around 2,000 trees to build [Ref. 4:p. 117]. By 1780, the first all-American ship in design and construction was commissioned. This warship, *RATTLESNAKE*, was a 420-ton corvette [Ref. 4:p. 202].

The period from the mid-eighteenth century to the early nineteenth century (1740 - 1840) is known as the Golden Age of Naval Exploration. During this time, naval vessels were being built to circumnavigate the world and to perform an increasing

array of scientific expeditions. This was the period of Parry and Darwin [Ref. 4:pp. 208 - 219]. European powers dominated in the area of naval exploration. Americans, on the other hand, turned their attention inward with the exploration of the North American continent.

In the nineteenth century, sailing vessels took on a new importance. Merchants began to see expanding opportunities with the growth in trade brought about by the Industrial Revolution [Ref. 5:p. 167]. China provided a source of demand for opium and a source of supply for tea [Ref. 4:p. 242]. Britain's factories were in need of American cotton to support England's manufacture and export of broadcloth, woolens, muslin, and calicoes [Ref. 6:p. 156]. This period also saw the rapid rise in demand for passenger travel with the discovery of gold in California and Australia in 1848 and 1851, respectively [Ref. 6:pp. 193 - 217]. In addition, immigration to the U.S. was exploding. Over 4,028,589 emigrants, most of them heading to the U.S., left Ireland between 1851 and 1905 [Ref. 5:p. 173]. The nineteenth century was an era of economic growth.

U.S. shipbuilders responded to this economic boom with the American Clipper. Clippers, so named because they could "clip" the time off a packet ship's regularly scheduled run, had the War of 1812 to thank for their origin. During the war, Congress had authorized a number of privateers who found

that speed, rather than cargo space, was a feature necessary for successful raiding against British merchants [Ref. 5: p. 199].

American shipbuilders excelled in Clipper design, particularly during the period 1845 - 1860. This was the "heyday" of the American Tea Clipper which was built for the tea trade between China and England. Contributing to the demand for more bottoms was Britain's repeal of the Navigation Act in 1849. The Navigation Act had mandated the use of Commonwealth bottoms for all British imports [Ref. 5:p. 199].

The discovery of gold in California brought new business opportunities for Clipper shipbuilders and shipowners. Immigrants seeking their fortune in California could (1) head west by wagon train, (2) steam to the Isthmus of Panama, cross the Isthmus by land, and then steam up to California, or (3) take the 16,000 mile trip around the Horn of South America on a Clipper. The most popular of the three choices was the Clipper ship [Ref. 7:p. 271]. Ships taking immigrants and supplies from New York to California, goods to China, and returning with tea to England could practically pay for themselves with one voyage [Ref. 6:p. 193]. Gold rush prices for supplies were extremely lucrative for shippers, even by today's standards (i.e., a dollar apiece for eggs and $40 a quart for whiskey) [Ref. 7:p. 271].

American builders were very successful during this period for several reasons. First, the U.S. was rich in untapped

natural resources, particularly forests. Second, relatively cheap labor was also available due to the growing number of immigrants. Third, demand for new ships was high due to the enormous profit opportunities brought about by the growing world economy.

Clippers were relatively cheap to build, but they also had short life spans. Shipyards usually used the wood from nearby forests which minimized transportation costs. The soft wood, however, lasted only about five years. A second factor contributing to the Clippers' short life span was the practice of ship captains to push their ships to the limit in an effort to have the shortest transit times [Ref. 5:p. 199].

Donald McKay, a renown builder of the time, launched 137 sailing vessels totalling some 137,280 tons during the Golden Age of the Clippers. McKay's *GREAT REPUBLIC*, launched in 1853, was built in response to the California gold rush and required "134,531 cubic feet of pine, 2,056 tons of white oak, 336 tons of iron, and 5.6 tons of copper" [Ref. 4:p. 249].

Due to advancing technology and the capabilities afforded by the Industrial Revolution, larger and larger Clipper ships were built. The Tea and Colonial Clippers of 1857 - 1875 were the first to use a combination of metal and wood [Ref. 4: pp. 244 - 247]. Composite ships, as these were called, had hull planking, decks, and a keel made of wood which were attached to keelson, frames, and deck beams made of iron. This combination resulted in a considerable weight savings as

well as greater cargo capacity [Ref. 5:p. 153]. Two famous composite ships were the *THERMOPYLAE* and the *CUTTY SARK* [Ref. 4:p. 244].

During the American Civil War (1861 - 1865), U.S. shipbuilders went into decline. They lost their Clipper design superiority to the British and were never able to regain their prominence [Ref. 5:pp. 200 - 201].

In any event, time was running out for the Clippers. Although technology was expanding their capabilities, technology was also accelerating their demise. According to Carl C. Cutler, a Clipper historian, Clippers climaxed in 1853 with 120 launches that year. By 1855 there were only 42 launches. Cutler believes that the last three "true" Clippers were built in 1859 [Ref. 7:p. 255]. A snapshot look at merchant ship tonnage during the nineteenth century can be seen in Table 1 below. The figures provide some indication of the vessel tonnage supported by shipyards of the time.

The technology of the nineteenth century produced the first steam and iron vessels. Metallurgy began its ascent in the U.S. from 1840. The dominance of steel soon followed in 1870 [Ref. 8:p. 4]. Fulton's historic steam trip up the Hudson in 1807 marked the birth of a new age -- commercially viable steam transportation[1]. Eight years later, Fulton

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[1] Fulton had to buy his steam engine from England due to the lack of American engineers with sufficient experience [Ref. 5: p. 148].

designed the first steam warship, *DEMOLOGOS*, which was launched too late for the War of 1812. By 1838, *SIRIUS* and *GREAT WESTERN* made the first steam-powered transits across the Atlantic. France and Britain launched the first iron-clad warships, *GLOIRE* and *WARRIOR*, in 1859 and 1861, respectively. Advancements in naval technology eventually led to the development of the Dreadnaught class of battleships in 1906 [Ref. 6:pp. 142 - 303].

TABLE 1. MERCHANT SHIP FLEETS OF 1875.

COUNTRY	NUMBER OF SHIPS	TOTAL TONNAGE
England	19,709	5,543,567
United States	7,312	2,387,876
Norway	4,718	1,360,663
Italy	4,469	1,222,832
Germany	3,477	853,290
France	3,877	751,854
Spain	2,888	551,201
Greece	2,092	418,689
Holland	1,471	403,788
Sweden	2,018	389,841
Russia	1,759	383,841
Austria	980	192,970
Denmark	1,291	176,941
Portugal	444	107,194

[Ref. 4:p. 231]

Steam ships ultimately displaced sail for economic reasons. Smaller crew sizes were required on steam ships.

Furthermore, the completion of the Suez and Panama Canals, in 1869 and 1914, respectively, also contributed to the demise of the Clipper fleets. These shortcuts eliminated the need for long trips around the capes of Africa and South America, and consequently, they eliminated the speed advantages associated with Clippers [Ref. 4:pp. 263 - 266]. The shift from sail to steam also produced a shift in shipbuilding dominance. Steam shipbuilding necessitated an industrial base. England, as the birthplace of the Industrial Revolution, was to reap the advantages of her newfound industrial capabilities.

Britain's ocean tonnage grew twelvefold between 1850 and 1910 [Ref. 9:p. 279]. At the outbreak of the First World War, Great Britain was to possess the largest maritime fleet with merchant shipping totalling 11.5 million tons. Not surprisingly, the Royal Navy, too, was the largest in the world with 65 battleships, 120 cruisers an a host of destroyers and smaller craft [Ref. 10:p. 89]. Britain also possessed the shipyard capability to support her large maritime interests at the start of the war.

U.S. shipyards, on the other hand, were not ready for the First World War. Prior to the outbreak of hostilities in 1914, there was virtually no wartime preparation in U.S. shipyards. Some U.S. businesses found themselves in extremis when foreign vessels were removed from U.S. commerce in the early stages of the war. Up to that time, British, French, German, and Italian vessels carried the bulk of America's

international trade. U.S. flag vessels had been concentrating primarily on coastal trade and only shipped approximately ten percent of the U.S. international trade [Ref. 11:p. 48].

The Shipping Act of 1916 established the Emergency Fleet Corporation (EFC) which was chartered to alleviate the impact caused by the loss of foreign bottoms. The EFC fulfilled its charter to "purchase, construct, and operate government vessels." The domestic shipyard expansion program initiated by the EFC eventually produced a national monthly capacity of 400,000 gross tons and a fleet of over 2,300 ships [Ref. 11: p. 48]. Unfortunately, all of the ships were delivered after the Armistice of 1918 had been signed. This glut of ships depressed the shipbuilding market during the 1920s as the post-war depression was setting in.

America's preparations for World War Two were considerably superior to those of the First World War. Nevertheless, weaknesses were still observable. Pre-war preparations enabled U.S. shipyards to produce in 1943 the same number of ships that were produced in the preceding twenty-five years using a work force that was seventeen times the previous twenty-five year average [Ref. 11:p. 49]. A summary of significant pre-war preparations follows:

- Roosevelt's National Industrial Recovery Act of 16 June 1933 initiated the Navy's buildup by authorizing numerous light cruisers, destroyers, carriers *ENTERPRISE* and *YORKTOWN*, and four submarines [Ref. 11:p. 50].

- The Vinson-Trammell Act of 1934 facilitated further wartime preparation by authorizing the building of 141 vessels of various types [Ref. 11:p. 50].

- The Merchant Marine Act was passed in 1936, thereby laying the groundwork for a modern U.S. merchant marine [Ref. 12: p. 117].

- Twenty Percent Expansion Act of 1938, the Eleven Percent Expansion Act of June 1940, and the Seventy Percent Expansion Act of July 1940 were all designed to prepare the Navy and the nation for war [Ref. 11:p. 50].

Sixty-eight shipyards were building naval vessels by February 1941 [Ref. 11:p. 51]. Adding to America's wartime preparations were: (1) orders from Britain for 60 dry cargo ships in 1940 followed shortly thereafter by a U.S. Government order for 200 more, and (2) President Roosevelt's declaration of an Unlimited National Emergency in 1941 which resulted in the acceleration of America's shipbuilding program [Ref. 11:p. 50]. Despite all of this preparation, the U.S. was still not ready for the shipping losses which were to be realized from late 1941 through 1942.

From 1939 to 1945 approximately 5,777 merchant vessels were built in the United States [Ref. 11:p. 53]. Concurrently, U.S. naval forces were constructed at a rate never to be equalled before or since. Between July 1940 and June 1945, American shipbuilders armed the "arsenal of democracy" with the following naval vessels: ten battleships, 18 large aircraft carriers, nine small aircraft carriers, 110 escort carriers, two large cruisers, ten heavy cruisers, 33

light cruisers, 358 destroyers, 504 destroyer escorts, 211 submarines, and 82,028 landing craft of various designs [Ref. 11:p. 53].

At the conclusion of the war, the shipbuilding capacity of the United States far exceeded the peacetime demand. As a result, many shipyards were closed as a part of America's demobilization effort. In addition, the U.S. Government sold off the vast majority of its inventory of merchant ships pursuant to the Merchant Ship Sales Act of 1946. Those ships which remained in the government's inventory after domestic and foreign demand had been satisfied (excess supply) were incorporated into the National Defense Reserve Fleet [Ref. 13:p. 20].

The flood of ships into the post-war market did little to promote world-wide shipbuilding. Compared to the annual production levels experienced during the Second World War, ship construction in the U.S. between 1949 and 1958 was unspectacular. Of the 206 ships built during this timeframe, 35 merchant ships were constructed under a Federal shipbuilding program in response to the Korean War [Ref. 14: p. 41]. Without this Federal shipbuilding program, the U.S. shipbuilding history covering this period would have been even less noteworthy. Appendix A illustrates U.S. production levels during this time frame.

The decline of U.S. shipyards continued into the 1960s. The gradual military buildup during the Vietnam War did not

create a big demand on U.S. shipyards. Sealift requirements were largely filled by the 150 National Defense Reserve Fleet vessels that were activated in support of the war effort

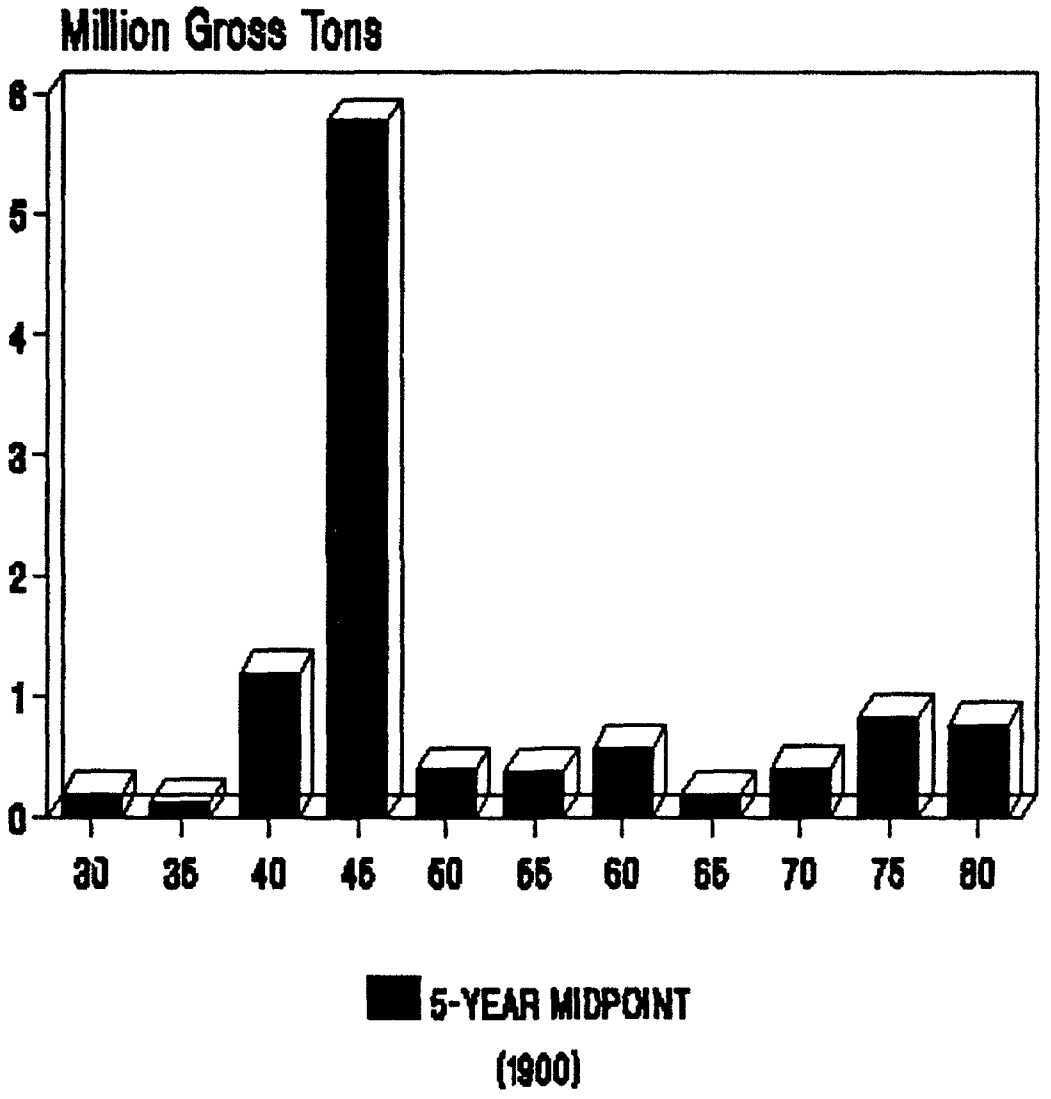

Figure 1. Merchant Ship Construction in U.S. Yards Five Year Average (1930 - 1980). [Ref. 12:p. 91]

[Ref. 14:p. 41]. Figure 1 shows the five-year average merchant ship construction in the United States from 1930 through 1980.

While post-Second World War shipbuilding has remained relatively steady in the U.S., in terms of gross tons, world seaborne trade has experienced significant growth as illustrated in Figure 2. Thus, U.S. shipyards have steadily lost commercial shipbuilding market share in absolute terms. U.S. shipbuilders averaged less than five percent of the world's demand for commercial ship orders from 1972 through 1982 [Ref. 12:p. 89]. In 1988 and 1989, U.S. shipyards had zero percent of the world's commercial shipbuilding market [Ref. 15:p. 21]. This drop in commercial shipbuilding contracts can also be seen in the Active Shipbuilding Industrial Base (ASIB). In March 1983, the ASIB consisted of 26 shipyards [Ref. 12:p. 88]. This figure dropped to 16 in 1990, a 38 percent decline in just seven years [Ref. 16: p. 48].

In the 1990s, the health of the American shipbuilding industry is still tied to the forces of global politics and global economics. Unfortunately, from the U.S. shipbuilding industry's standpoint, global economics and global politics have been weakening the U.S. industry rather than providing the shipyards with an environment conducive to a strong U.S. shipbuilding industry.

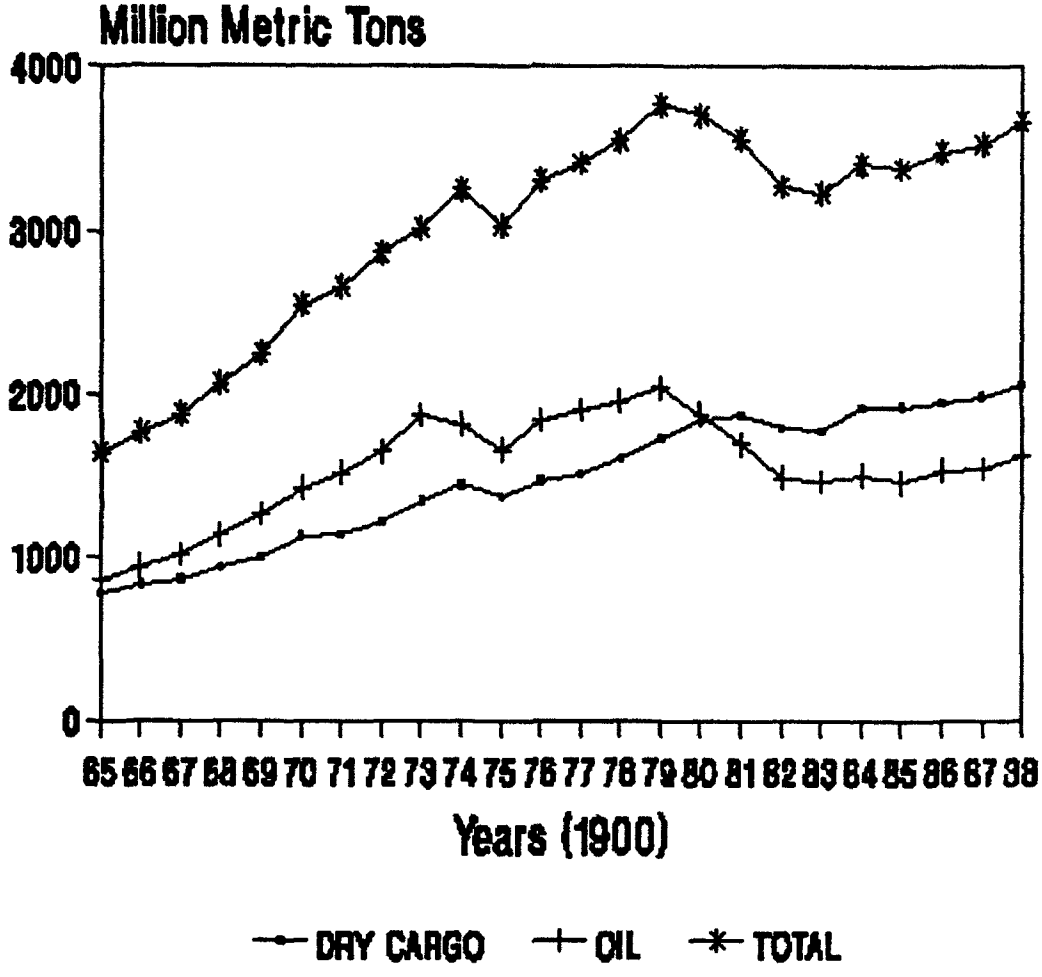

Figure 2. Development of World International Seaborne Trade (1965 - 1988). [Ref. 17:p. 147]

The decline of U.S. shipyards is attributable to many factors including overcapacity within the industry, the cyclic nature of the industry, the impact of both foreign and domestic subsidies, the productivity of American shipyards relative to their competition world-wide, and the economic realities of labor rules, wages, and unions.

The American shipbuilding industry has declined to a point where national concern is warranted. The United States is the world's largest trading nation and its economy relies heavily on the movement of goods and services into and out of the country [Ref. 12:p. 3]. In addition to providing the economic grease for a capitalistic society, trade is also a necessity when it comes to strategic materials that are not available within the United States in the quantities required for national defense purposes. By far, the vast majority of American imports and exports are transported by ships. This reliance on the sea, then, makes it prudent that America maintain a capability to build and repair ships in quantities required to meet national defense needs. Despite this need, current trends are pointing to a death knell for still more American shipyards.

B. OVERVIEW OF THE SHIPBUILDING PROCESS

Shipbuilding is a unique industry in many respects. The demand for shipbuilding, complexity of the manufacturing process, capital and labor requirements, and national defense issues all combine to give shipbuilding its individualistic character in the industrialized world. These features that give the shipbuilding industry uniqueness also contribute to the wildly cyclic business patterns that are a hallmark of the industry. Since 1896, the world shipbuilding industry has experienced over nine major cycles, three of which have

occurred since World War II. During these cycles, demand for new ships dropped by over forty percent [Ref. 12:p. 87]. To more fully understand how these factors impact on the cyclic nature of shipbuilding, each is addressed more fully in the sections that follow.

1. DEMAND FOR SHIPBUILDING

Like all transportation needs, demand for new ships is derived demand [Ref. 18:p. 518]. Shipowners do not contract to have ships built unless the demand for carrier services is sufficient to justify the costs and the risks associated with the construction and the operation of a new ship. In essence, the root of shipbuilding demand is world trade. As international trade increases, shippers will demand more capacity on the part of carriers. Up to a point, carriers can increase their capacity by increasing operating speed, reducing turnaround time in port, and by bringing older, less efficient ships out of lay-up [Ref. 19:pp. 81 - 91].

As demand for bottoms continues to increase, carriers are able to justify higher freight rates in order to rationalize their capacity. Beyond a given point, however, economics dictates that the shipowner must contract for a new vessel. With a newer ship, the shipowner is able to increase his capacity while possibly reducing operating costs due to the ship's modern technological design (i.e., fuel-efficient engines and automation to reduce manning requirements). Until

such time as shipowners are convinced that a requirement for new capacity exists, shipyards must confine their activities to either repair or special order contracts (i.e., custom work). This cyclic business pattern creates a challenge for shipyard management. Not only must management be prepared to take advantage of surging demand for new ships, but when business is in decline, management must also be able to husband labor and capital resources without jeopardizing the viability of the shipyard until the next growth cycle.

2. COMPLEXITY OF THE MANUFACTURING PROCESS

Ship construction is a complex operation because a ship is a highly specialized product that requires a significant amount of time to complete. Shipyard management has the responsibility to coordinate thousands of workers in the completion of work packages that can number in the tens of thousands. The workers must be trained and supervised. In addition to the worker scheduling effort, there must also be coordination with subcontractors and the shipyard supplier industry to deliver material, components, and equipment when and where they are needed. Due to the serial nature of shipbuilding, delays in any area can impact on the completion of the ship and, thereby, impact on the productivity of the shipyard [Ref. 2:pp. 10 - 11].

Furthermore, the physical composition of shipyards (i.e., quays, berths, etc.) makes it extremely difficult for

shipyards to convert their efforts from ship construction to some other business using the same facilities. Thus, once a firm is committed to shipbuilding, it cannot easily convert the business without considerable expense and time. Consequently, a shipyard's business strategy during industry-wide downturns usually requires the firm to ride out the slump [Ref. 11:p. 49].

3. CAPITAL AND LABOR REQUIREMENTS

Commercial and naval shipbuilding require major infusions of capital and labor [Ref. 12:p. 87]. Capital is required in order to purchase, maintain, and modernize shipbuilding facilities, to procure the raw material, subassemblies, and equipment from the shipyard supplier base, and to finance other shipbuilding operations such as payrolls, utilities, and taxes. Prior to 1945, shipyards characteristically manufactured the entire ship in-house and used purchased components sparingly. Increasingly, however, more and more of the subassemblies and equipment are purchased from outside sources. This trend is turning the shipbuilding industry from a manufacturing-oriented business to an assembly and erection industry [Ref. 12:p. 96].

Labor is another major resource used in the construction of modern ocean-going vessels. Like capital, labor is used in large quantities. Direct labor costs can account for as much as fifty percent of the finished cost of

a ship [Ref. 12:p. 107]. Shipyards must hire, train, and maintain a work force capable of performing the myriad of tasks required by modern naval technology (i.e., fabrication, assembly, production, and management). Labor skills required include: welders, shipfitters, joiners, painters, machinists, electricians, and pipefitters.

Due to the cyclic nature of the industry, however, it is becoming increasingly difficult to attract and retain skilled workers when job security is all but nonexistent [Ref. 12:p. 102]. The labor force is typically one of the areas targeted for cutbacks when shipyards experience a downturn in total construction and repair business. Released workers tend to find work in another industry in the same area, rather than relocate geographically to a new area in order to remain in the shipbuilding industry [Ref. 11:p. 59].

4. NATIONAL DEFENSE ISSUES

The uncompetitiveness of American shipyards combined with the expected decline in shipyard capability present grave national defense issues. International trade is an important aspect of the U.S. economy. As the world's largest trading economy, American industry and consumers depend on foreign trade for raw materials, semi-finished, and finished products. In turn, foreign markets provide sales opportunities for American businesses. Since practically all international

trade is carried on ships, shipbuilding and shipping become national defense issues [Ref. 12:p. 3].

Aside from the issues of trade, adequate shipbuilding capacity and sealift capability are required in order to meet defense commitments to foreign governments as well as to protect the worldwide strategic interests of the United States. Despite the breakup of the Soviet Union, there are other threats in the world which can have a devastating impact on the U.S. or her allies (i.e., another regional war such as Desert Storm or a second oil embargo by the Organization of Petroleum Exporting Countries [OPEC]). A less sinister scenario, but no less damaging in its potential, is the growth of "trading blocs." A trading bloc which controls a large portion of the world's merchant fleet could control that fleet to the disadvantage of blocs reliant upon those bottoms (i.e., shipping rates could be manipulated in a manner just short of a trade war). U.S. shipyard capability is protection against a reliance on foreign shipyards to fulfill the needs of U.S. shipping in peace or war.

The loss of shipbuilding orders by U.S. shipyards also hits the shipbuilding support industry. Marine suppliers who are unable to maintain their profitability by supporting the U.S. shipbuilding industry will either go out of business or convert to another line of business. Table 2 shows some of the items which must currently be purchased from foreign sources due to a lack of domestic sources of supply.

Table 2. TYPICAL FOREIGN PROCUREMENTS.

ITEM	SHIP CLASS	COUNTRY
Arresting Gear Engines	CVN-68	Netherlands
Propellers	T-AGOS 1	Japan
Quiet Ball Bearings	SSN 688, SSBN 726, CG 47	Japan
Turbochargers	T-AO 187	Switzerland
Diesel Generator Sets	T-AO 187	Norway
VLS Strike Down Cranes	CG 47, DDG 51, DD 963	Sweden
Diesel Engines, Non-magnetic	MCM 1, MHC 1	Italy
Air Compressors	T-AO 187	Great Britain
Power Supplies	CVN 68	Denmark
Periscope Lens Material	SSN 637, SSN 688	Germany
MK 75 Gun	FFG 7	Italy
Transmitter/Receiver AN/URC 109	LHD 1	Great Britain
Cold Drawn Seamless Tubing 4" and Above	Submarines	Germany
Crankshafts for Propulsion Diesel Engines	T-AO 187	Germany
Anchor Chain, 4-3/4"	CVN 68	Sweden
Air Circuit Breakers	CG 47	Great Britain
Degaussing Systems	MCM 1	Great Britain

[Ref. 20:p. 169]

With a further decline of U.S. Navy construction, a further contraction of U.S. shipyard capability, and a

continuing lack of commercial merchant shipbuilding orders, the length of Table 2 is expected to grow. Each item added to the list is an indication that U.S. naval construction is becoming increasingly dependent on foreign sources of supply. Furthermore, a growing foreign purchase list indicates a shrinking U.S. shipbuilding supplier base. Both indicators are a cause for alarm given a wartime scenario.

C. U.S. SHIPYARDS

Aside from the Clipper era, the United States has never been either a dominant shipbuilder or shipowner in a peacetime environment [Ref. 19:p. 297]. World War Two was the high water mark for America's shipbuilders. This boom in construction followed the stagnated period during the Great Depression where the U.S. merchant ship production had reached a low of 63,000 tons in 1935 [Ref. 11:p. 50]. The importance of Navy work to U.S. shipbuilders grew significantly in the years just prior to America's entry into World War Two as President Roosevelt began to prepare the nation for war. Navy work in the shipyards continued to grow throughout the war. In June 1940, only six private yards were doing Navy work, but by the end of 1941, 68 yards were building naval vessels. The peak was reached in 1943, when the number of ships built in U.S. yards was greater than the total built during the preceding twenty-five years [Ref. 11:p. 49-51].

Throughout the war, shipyard capacity was expanded by over 400 percent. Twenty-one emergency shipyards were built by the Maritime Commission. In addition, forty-three private yards were financed by the Maritime Commission while eighty yards were financed by the Navy for a total of $851,000,000 [Ref. 11:pp. 49 - 52]. At the conclusion of the war, excess shipyard capacity was quickly eliminated.

There are several observations with regard to trends in U.S. shipyards since 1945. First, U.S. shipyards have been uncompetitive in the world shipbuilding market despite the great advantage obtained during the war. Second, due to the declining commercial market, U.S. shipyard work has been shifting from commercial to Navy construction. Third, U.S. yards have been concentrating more effort on repair work than new construction as their order books go empty. Fourth, there is increasing competition between private and public yards for Navy overhaul and repair work as the commercial market opportunities continue to shrink for U.S. shipyards. Each of these trends are discussed below.

1. Uncompetitiveness of U.S. Shipyards

Since 1960 the U.S. has not been able to obtain more than a few percent of the world's shipbuilding market share [Ref. 19:p. 294]. U.S. shipyards have basically priced themselves out of the world commercial shipbuilding market while Japan, Korea, and Europe have maintained a competitive

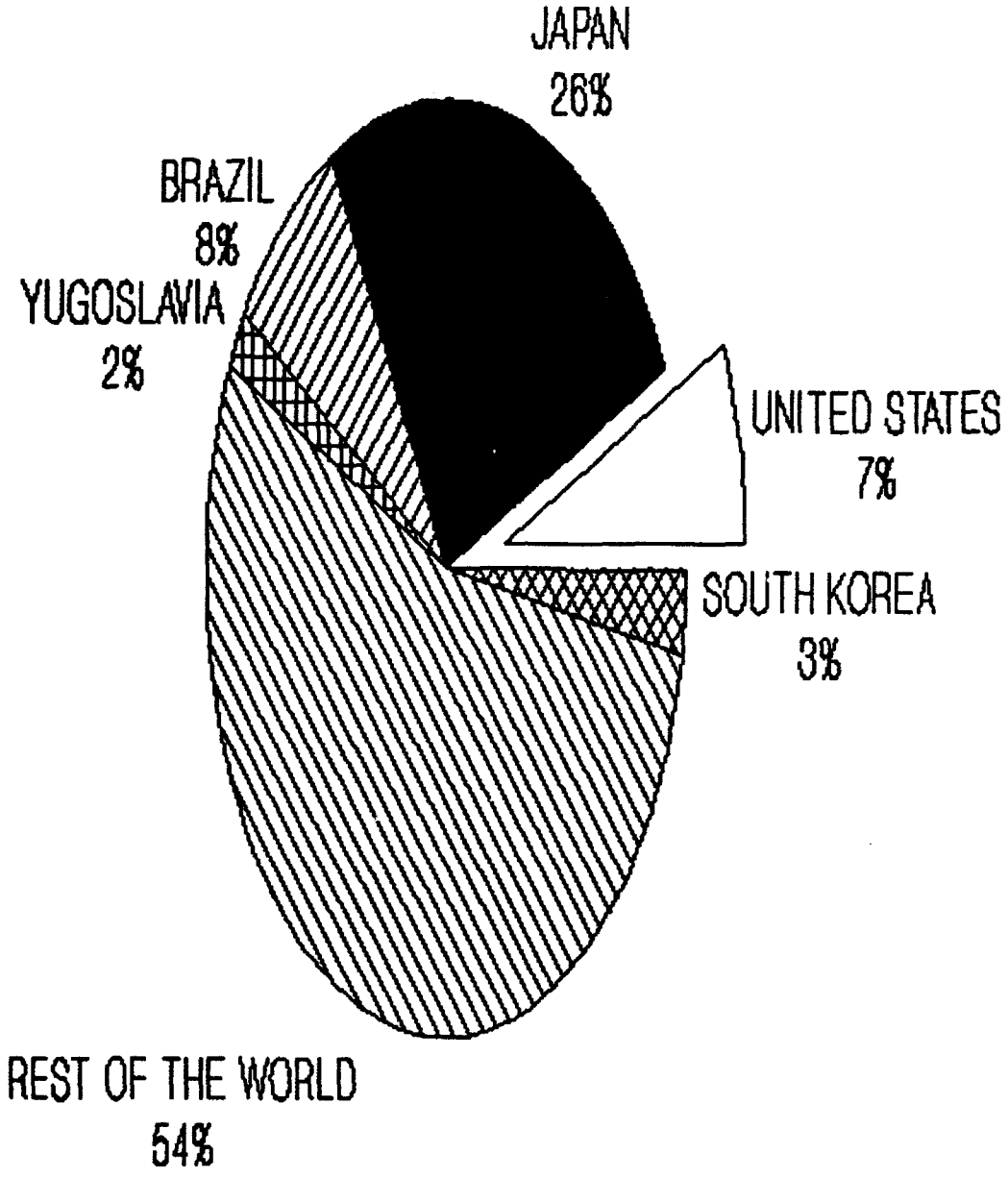

Figure 3. World Percentage of Commercial Vessel Tonnage on Order 1 January 1978. [Ref. 21:p. 11]

posture. Figure 3 shows commercial vessels on order in 1978 prior to the commencement of the Reagan naval buildup in the U.S. Figure 4 shows commercial ships on order in 1990

following ten years of concentrated U.S. naval construction and eight years after the elimination of U.S. Construction Differential Subsidies. During these twelve years the U.S.

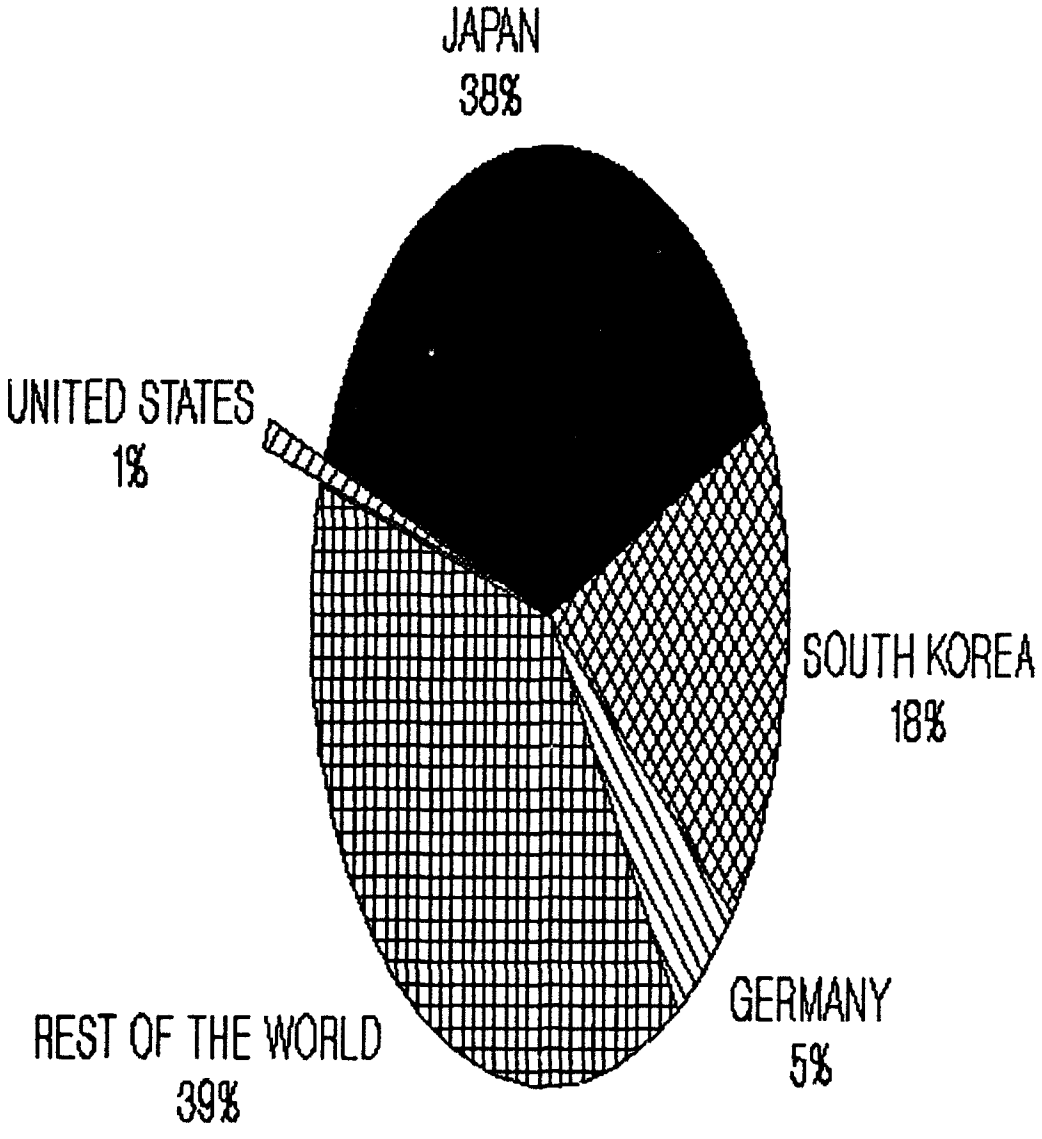

Figure 4. Commercial Vessel Tonnage on Order 31 December 1990. [Ref. 15:p. 18]

shipbuilders' percentage of the world commercial shipbuilding market fell from 6.5 to .7 percent.

A contributing factor to the decline in U.S. yards was their reliance on federal support [Ref. 12:p. 85]. Federal assistance to U.S. shipyards included Construction Differential Subsidies (CDS), cabotage laws, tax benefits, and Government construction programs (Navy and Coast Guard). Chapter III discusses federal involvement in further detail.

Labor rate growth in the U.S. has also played a part in the declining competitiveness of U.S. shipyards. When direct labor accounts for up to fifty percent of the finished price of a ship, labor rates become significant in terms of a shipyard's competitiveness. The U.S. shipbuilding industry is heavily unionized and is noted for its lack of incentive pay systems [Ref. 22:p. 56]. During the five-year period between 1975 and 1980, U.S. shipbuilding labor rates increased 57 percent. Conversely, labor rates only increased by 26 percent in Japan and by 38 percent in West Germany over the same timeframe [Ref. 12:p. 105]. Recent data, however, indicate that the U.S is very competitive in shipbuilding compensation costs as illustrated in Table 3.

TABLE 3. SHIPBUILDING HOURLY COMPENSATION COSTS (INCLUDING FRINGES). (MEASURED IN DOLLARS PER MAN-HOUR)

COUNTRY	1988	1989	1990
GERMANY	$20.89	$20.16	$26.50
NORWAY	19.88	19.63	24.36
DENMARK	16.99	16.23	21.86
NETHERLANDS	15.87	N/A	21.70
ITALY	14.62	15.10	19.22
FRANCE	14.51	14.09	18.60
JAPAN	14.83	14.67	15.80
USA	14.33	14.77	15.50
U.K.	9.89	10.06	12.55
KOREA	4.40	6.35	10.00

[Ref. 23:p. 37]

2. Shift from Commercial to Navy Work

Due to their lack of competitiveness on the world market, the big five U.S. shipyards have steadily been moving out of commercial shipbuilding and into the Navy repair and construction markets. Figure 5 illustrates this point graphically. Like all businesses which rely on one source of income, the big five U.S. shipyards have become dependent on Navy work for their livelihood. Consequently, their profits, losses, and health currently depend on the Navy's corstruction and repair budget. For the past several years, Naval construction has supported approximately ninety percent of the work at the top five U.S. shipyards [Ref. 1:p. 3]. According to a 1990 Shipbuilders Council Survey, of the $1.632 billion

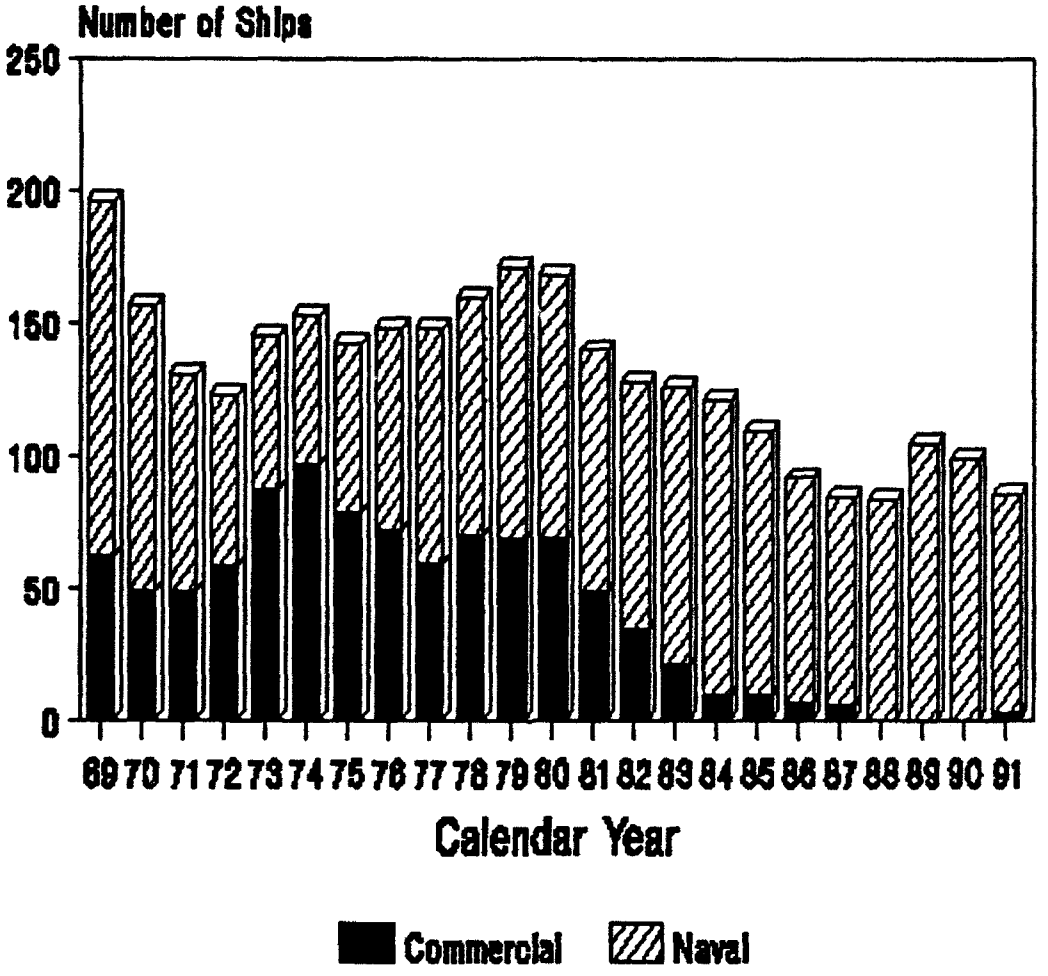

Figure 5. Commercial and Naval Ships on Order (1969 - 1991). [Ref. 15:pp. 5 - 9 and Ref. 16:pp. 52 - 53]

spent in U.S. shipyards for repair, $1.200 billion or 73.5 percent came from Navy and Coast Guard sources [Ref. 24: p. 20].

3. Growth of Repair/Specialty Work over Construction

Several major U.S. shipyards, unable to attract either Navy or commercial shipbuilding contracts, have become more and more reliant on repair and specialty work as a matter of

survival. Private shipyards spent approximately $300 million for improvements in 1983 -- most of it for repair and conversion facilities. Like the construction side of the industry, only a few yards account for the vast majority of repair dollars [Ref. 14:p. 20].

A major source of federal repair work comes from the Navy's repair and modernization program which has been declining in recent years due to changes in the Navy's maintenance policy and due to the increased reliability of Navy ships achieved by the Reliability Improvement Program.

A second major source of federal repair work comes from the National Defense Reserve Fleet (NDRF) which consists of 220 merchant ships and 30 naval vessels. A subset of the NDRF is the Ready Reserve Force (RRF) which is maintained in a higher state of readiness than the NDRF as a whole. The RRF is scheduled to contain 142 ships by FY 1995. Average annual maintenance expenditures for each RRF ship is estimated by MARAD to total $1 million. Activation, conversion, and maintenance of the ships to be added to the RRF is expected to run approximately $60 million per year [Ref. 1:pp. 4 - 5].

Additional repair funding has resulted from Desert Shield and Desert Storm. The activation and deactivation of 78 RRF ships in support of these operations will result in approximately $330 million worth of business for 25 U.S. shipyards. Furthermore, test-training activations over the next three years could result in another $250 million for U.S.

shipyards [Ref. 1:p. 5]. Although the work from Desert Shield/Storm is significant, from a long term perspective, this is only a one time source for work for U.S. shipyards. Repair revenues in U.S. yards for the years 1988 through 1990 are shown below in Table 4.

Table 4. REPAIR REVENUES (MILLIONS) IN U.S. SHIPYARDS (1988 - 1990).

Source	1988	1989	1990
Government	$1,238.0	$1,091.1	$41,119.3
Commercial	$201.8	$278.7	$373.3

[Ref. 25:p. 3]

4. Competition Between Private and Public Yards

With the decline in commercial shipping contracts has come a demand by private shipyards for a greater share of the Navy's repair work. In FY 1974, Congress established a ceiling of 70 percent for repair and modernization work in public shipyards. The remaining 30 percent had to be competitively awarded to private shipyards. The competition program was expanded by the Navy in FY 1986. Since that time, public shipyards have won the majority of the nuclear submarine repair availabilities while private shipyards have won the majority of the non-nuclear surface ship repair availabilities [Ref. 26:p. 8].

The percentage of repair and modernization funds awarded to private yards for FY 1989 through FY 1991 is

presented in Table 5. The distribution of repair availabilities (i.e., Phased Maintenance Availabilities - PMAs, Scheduled Maintenance Availabilities - SRAs, and Restricted Overhauls - ROHs) to public and private shipyards during the period 1982 through 1989 is presented in Table 6 and Figures 6 and 7.

Table 5. REPAIR AND MODERNIZATION WORK AWARDED TO PRIVATE SHIPYARDS ON A COMPETITIVE BASIS.

YEAR	DOLLAR VALUE AWARDED (BILLIONS)	TOTAL OF NAVY REPAIR AND MODERNIZATION WORK (PERCENTAGE)
1989	1.8	41.9
1990	1.73	37.4
1991	1.5	41.7

[Ref. 1:p. 4]

Future public/private competitions could be affected by the closure of Philadelphia and Long Beach Naval Shipyards. Normally a decrease in public shipyard capacity would tend to result in an increase in work for other shipyards (public or private). This may not be true, however, in a period where the size of the Navy fleet is declining. Consequently, it is still too early to tell what impact the closure of these two public yards will have on future competitions [Ref. 1:p. 4].

Over the course of American history, U.S. shipyards have experienced first hand the rise and fall in demand for

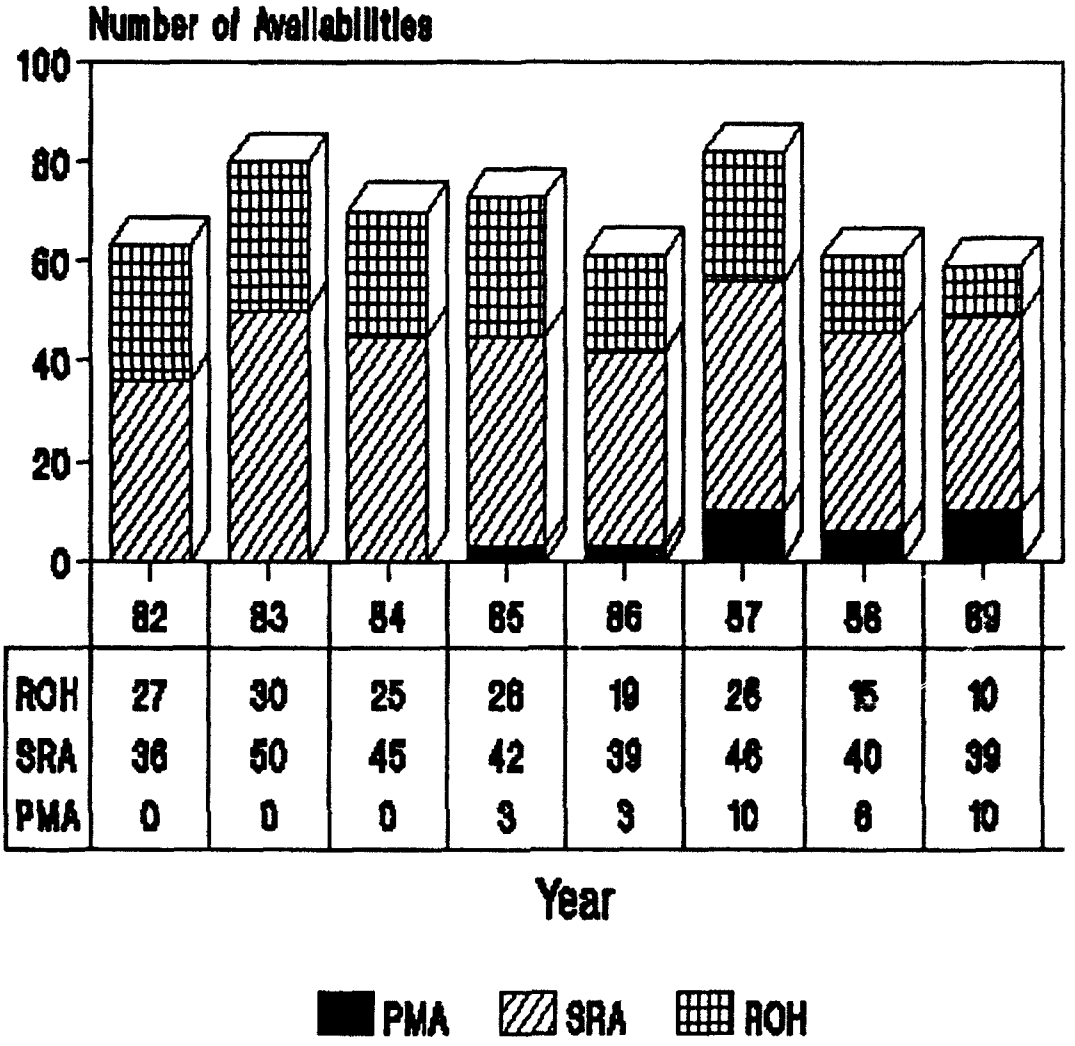

Figure 6. Distribution of Repair Availabilities at Public Yards. [Ref. 26:p. 5]

American-built ships. Peaks during the Clipper Age and the First and Second World Wars were followed just as quickly by deep troughs of stagnated demand. The decline in U.S. shipbuilding supremacy from the end of the Second World War to the present is addressed in the following chapter.

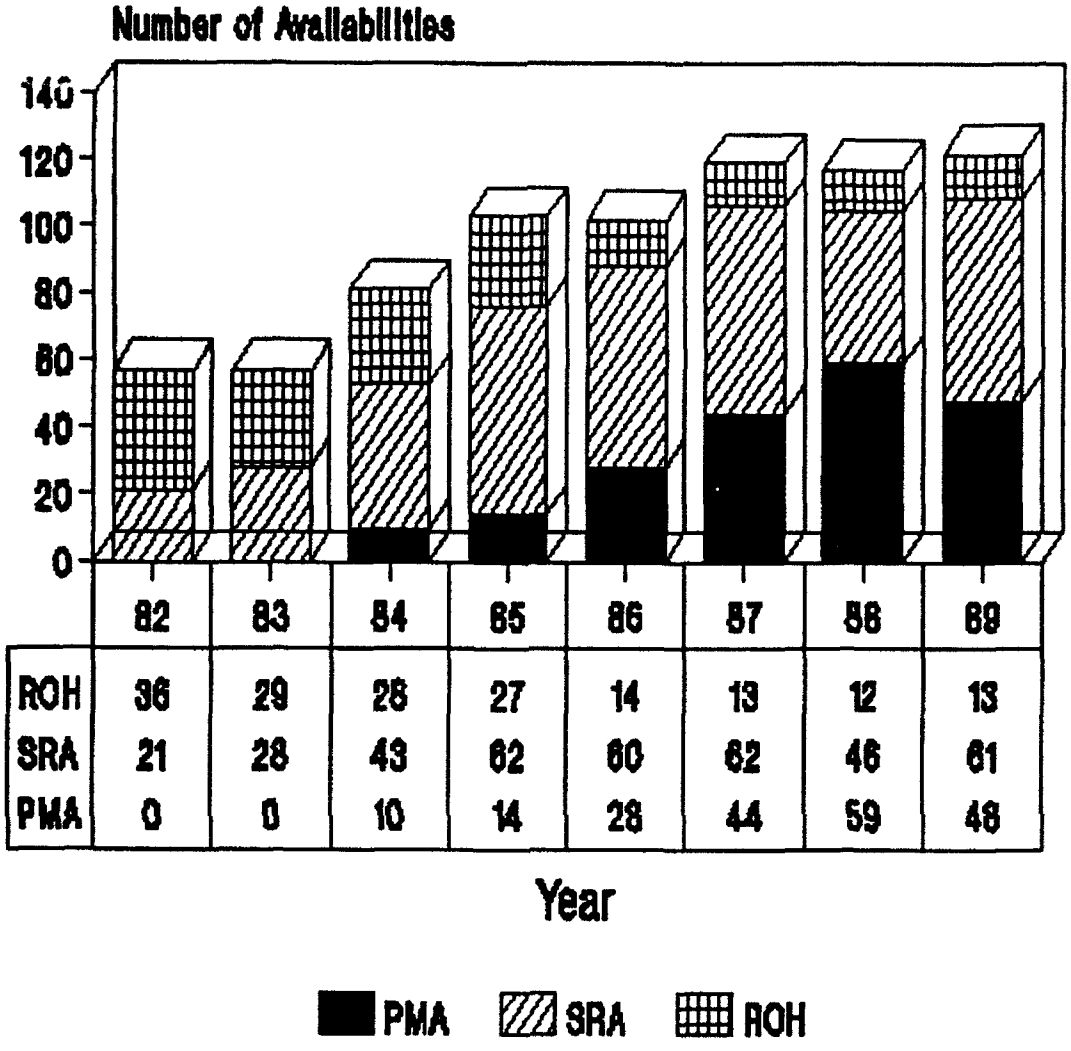

Figure 7. Distribution of Repair Availabilities at Private Yards. [Ref. 26:p. 5]

III. CAUSES OF THE DECLINE

The decline of U.S. shipyards since the end of World War Two can be attributed to four major causes. These include: overcapacity within the industry, the cyclic nature of the industry, foreign competition, and U.S. influences. This chapter will address each of these issues in detail.

A. OVERCAPACITY

Overcapacity is the primary reason for the decline in the numbers and the decline in the capacity of U.S. shipyards from their peak during the Second World War. At the war's end, the U.S. had capacity far in excess of peacetime demand. In addition, at the conclusion of the war, there was a glut of merchant ships available for peacetime use. This glut further depressed demand for new ship orders. Consequently, the industry had to downsize to a level more aligned with peacetime demand.

Another factor contributing to overcapacity was the rebuilding of foreign shipyards in those countries that had been devastated by the war. Japanese and European yards were brought back into production not only to support their domestic shipping needs (and national policy in the case of Japan), but also to gain hard currency by selling new ships to the world's shipowners. Japan became a significant

shipbuilding force by 1950, was overtaking Great Britain by 1958, and commanded 50 percent of the world merchant shipbuilding market by 1969 [Ref. 19:p. 291].

The growth of national airlines in the early 1950s further exacerbated overcapacity. By 1952 several national airlines had established long distance routes that cut into the liner market [Ref. 5:p. 260]. As the airline industry matured, fewer and fewer liner passenger miles were demanded, equating to a softer and softer demand for new passenger liners.

The mid-1950s and early 1960s witnessed a growing demand for oil by the industrialized nations. This demand absorbed the excess supply of tankers which were present at the end of the Second World War and generated a new growth cycle in tanker builds.

The 1960s and early 1970s were the modern "golden age of shipbuilding." New merchant ship orders, particularly tankers, rose to record levels. Tanker demand soared in 1967 following the closure of the Suez Canal and rose constantly from 1968 through 1973 [Ref. 27:pp. 5 - 7]. European and Japanese shipbuilding capacity increased by 136 and 650 percent, respectively, over a ten-year span in response to (1) growing demand for ocean transportation, (2) national initiatives to promote industrialization and employment [Ref. 27:p. 7], and (3) market responses for the unprecedented world-wide merchant ship demand. [Ref. 21:p. 10].

Japan capitalized on this new demand by mastering mass production techniques, reducing construction times, and offering attractive financing [Ref. 27:pp. 5 - 7]. Conversely, total U.S. merchant ship construction remained relatively stable. From 1973 to 1982, U.S. shipyards averaged less than 5 percent of the total world commercial tonnage [Ref. 12:p. 89]. Tanker demand nose dived after the 1973 oil embargo by the Organization of Petroleum Exporting Countries (OPEC). From 1977 through 1988 demand for oil dropped 28 percent.

Tanker tonnage demand over the same period dropped 51 percent [Ref. 27:p. 9]. Since tankers had accounted for more than half of the new ship orders during this modern "golden age," shipyards found themselves with serious excess capacity [Ref. 21:p. 10].

Coupled with the tremendous drop in tanker demand was the modest growth in seaborne trade from 1979 to 1989. Oil tonnage dropped at an average of 2 percent per year while dry cargo tonnage rose at a rate of 2 percent per year [Ref. 17: p. 45]. Nominal growth in demand for seaborne transportation virtually eliminates the need for new capacity requirements on the part of shipowners. Replacement demand, then, becomes the primary order type shipowners place with shipyards. Given these market conditions, it is not surprising that world shipbuilding capacity by 1989 was 25 percent less than that in 1970 [Ref. 28:p. 26].

B. CYCLIC NATURE OF THE INDUSTRY

As mentioned previously, the world shipbuilding industry is known for wild oscillations between periods of feast and famine. The primary cause of these oscillations is world trade. If world trade grows annually, the demand for new shipping will continue to grow year by year. New demand is created by the need for more capacity on the part of shipowners as well as the need to replace older, less efficient vessels. If, on the other hand, world trade declines for a period of several years, demand for new shipping can dry up completely. Due to the need for less capacity, shipowners can retire their older vessels without replacing them [Ref. 19:p. 304]. When this occurs, new ship orders will drop precipitously.

While shipyards can possibly survive with inefficiencies during periods where demand for new ships exceeds the industry's capacity to build them, such inefficiencies tend to make these shipyards less competitive during periods of declining demand. It is the periods between peak to trough that are the biggest challenge to shipyard management. Shipyards must be able to maintain their facilities and their people during these slowdown periods without going bankrupt. Economic theory would predict that the less efficient shipyards in America are the ones that go out of business during periods of weak demand.

C. FOREIGN COMPETITION

To be competitive in the world shipbuilding market, U.S. shipyards must be able to meet or beat the quality and the prices for new ships offered by the world competition. To accomplish this feat, U.S. shipyards must overcome distinct disadvantages in labor rates and foreign government involvement.

1. LABOR RATES

Traditional thinking on factors that contribute to strong shipbuilding industries include a country's labor rates. As labor costs can account for anywhere from 40 to 50 percent of the final cost of a ship, labor rates are a key element in the bottom line calculation of a ship's total cost [Ref. 12:p. 107]. Labor rates, then, can significantly affect the final price of a new ship. Using this rationale, the movement of shipbuilding strength from Great Britain and Western Europe to Japan and to newly developing countries like Korea can be explained, particularly since labor rates in both Japan and Korea were well below those of the U.S. and Europe in the twenty years following the Second World War. As labor rates climbed in the United States and Europe, their shipyards became less competitive with these emerging shipbuilding countries.

Although labor rates are important in that they significantly contribute to the total cost of a new build,

labor rates alone do not determine the competitiveness of one shipyard against another. Japan too began to lose market share for new builds as Japanese labor rates outpaced those of South Korea. In 1987, South Korea's share of worldwide orders hit an all time high of 30 percent, while Japan's 34 percent share in the same year reflected a 20 year low. By early 1989, however, Japan's market share reached 45 percent of worldwide orders while South Korea's had dropped to 27 percent. This dramatic turnaround is attributable not only to the 60 percent rise in South Korean wages over the two-year period, but it is also due to the generous wage contracts being negotiated in South Korea's steel industry which further escalated the cost of South Korean ships [Ref. 29:p. 134]. Thus, although labor rates are important to being a competitive shipbuilder on the world market, other costs also play a part in the total cost equation for a new ship, impacting a nation's shipbuilding competitiveness.

2. FOREIGN GOVERNMENT INVOLVEMENT

U.S. shipyards must also compete on the basis of advantages offered to foreign shipyards by their respective governments. These advantages take the form of subsidies, shipyard ownership, and other forms of involvement.

a. Subsidies

Numerous foreign governments have decided that shipbuilding is in their national interests. Some of these

governments have also determined that their shipyards are not as efficient as the foreign competition. Consequently, these governments have decided to subsidize their own shipyards in order to keep them open and active in the shipbuilding trade. Foreign subsidies vary by country with regard to the types and magnitude of the subsidies available. Although a complete analysis and comparison of foreign subsidies is beyond the scope of this paper, the following subsidies are the most common found in the major shipbuilding countries of the world.

(1) Ship Financing Subsidies. Ship financing subsidies aid foreign buyers (export credits) or domestic buyers (home credits) in the purchase of ships built by the country providing the subsidy. Examples of ship financing subsidies include: loans, interest subsidies, and/or loan guarantees. The loan guarantees may be supported by various government entities including federal, regional, and state institutions and these guarantees may be either fully or partially supported. Government assisted finance programs exist in Japan, South Korea, and Europe [Ref. 30:p. 5].

(2) Ship Production Subsidies. Ship production subsidies take the form of direct cash infusion into a shipyard to cover a percentage of a contract price for a new build, repair, or conversion. This form of subsidy is prevalent in Europe and was established to maintain the competitiveness of the European yards with those yards outside

the European community, particularly those in the Far East [Ref. 30:p. 9]. The ceilings on these types of subsidies are set by the European Community (EC) Commission. Member governments are then supposed to abide by the limits established. These ceilings, however, do not apply to shipbuilding grants and financial aid provided to ship buyers from Less Developed Countries (LDCs) [Ref. 31:p. 3].

The EC's Sixth Directive detailed policies and regulations on ship production aid, investment and restructuring aid, and some forms of indirect aid for the period January 1, 1987 through December 31, 1990. Subsidy ceilings for the four-year period based on contract prices were: 28% (1987), 28% (1988), 26% (1989), and 20% (1990). The Directive allowed the ceilings to be set annually and excluded Spain and Portugal through 1990 [Ref. 30:p. 9].

The EC's Seventh Directive calls for the progressive removal of shipbuilding subsidies by EC members. In this vein, the EC lowered the maximum rate of government subsidies for 1992 from 13 to 9 percent [Ref. 32:p. 4].

(3) Restructuring and Investment Aid.

Restructuring and investment aid provides direct financial assistance to a shipyard. Modernization, restructuring, and downsizing are common purposes for this type of subsidy. A recent example of this type of subsidy is the Canadian Government's offer to help British Columbian

shipyards reduce capacity or close down yards by paying half of the cost [Ref. 33:p. 3].

Financial aid, however, can also be provided to keep a shipyard in business. Restructuring and investment aid can take the form of loan subsidies and guarantees, cash infusions, government purchases of excess or obsolete equipment, tax benefits, debt bail-outs, or other actions which assist the shipyard in covering operating losses. Major restructuring and investment programs exist in Japan, South Korea, Germany, and Italy [Ref. 30:pp. 11 - 12].

(4) Research and Development (R&D). All of the major foreign shipbuilding countries provide some sort of research and development assistance to their respective shipbuilding industries. Germany provides funds to both shipyards and to research institutes and universities for shipbuilding R&D. South Korean R&D efforts focus on ship design automation. Denmark emphasizes shipbuilding research and technological vessel development. Finally, Italy funds research in ship design and propulsion systems, and pays up to half the cost of prototypes [Ref. 30:pp. 15 - 18].

Perhaps the strongest shipbuilding R&D effort is being made by the Japanese. The close cooperation between industry, government, and universities has helped produce efficiencies in directing and promoting shipbuilding R&D, the results of which are reflected in Japan's share of

the world shipbuilding market. Prior to 1974, Japan had concentrated on lowering production and operating costs. Later, emphasis was placed on technological innovation following recommendations by Japan's Council for Rationalization of the Shipping and Shipbuilding Industries (CRSSI). CRSSI is comprised of representatives from the government, shipbuilders, and shipowners and acts as an advisory council to the Ministry of Transport (MOT) [Ref. 19: p. 295].

There are other government sponsors of R&D in Japan as well. The Council for Transport Technology (CTT) has promoted the development of artificial intelligence and high reliability in modern vessels. A propellerless ship has been designed by the Japan Foundation for Shipbuilding Advancement with the aid of government research funding. The Association for Structural Improvement of the Shipbuilding Industry was set up by the government in 1989 to identify and fund R&D projects which are considered to be too risky for industry. Furthermore, the Japanese government has funded the Ship Research Institute (SRI) since 1963. SRI's research and testing is done in consonance with policies formulated by the MOT [Ref. 30:p. 15].

b. Government Ownership Interest.

Government ownership interest in foreign shipyards makes it highly probable that operating losses will be covered

and that government policies will be developed which will keep the shipyard in business. Government ownership interest in shipyards exists in Germany, Italy, and Spain. The German government has provided around $254 million to Germany's primary shipbuilding groups, Bremer Vulkan and Howaldtswerke Deutsche Werft (HDW), between 1987 and 1990. The state of Bremen owns approximately 26.1% of Bremer Vulkan as well as ownership interest in other German yards. Similarly, the state of Schleswig-Holstein also has ownership interest in several German yards. Additional government assistance has been provided in the form of grant and financing aid for shipbuilding contracts from LDCs. Currently, neither the Organization for Economic Cooperation and Development (OECD) nor the EC limit the amount of subsidization that governments can provide for ship contracts placed by owners from LDCs [Ref. 34:p. 20].

The Italian government owns approximately 70 percent of that country's shipbuilding capacity and is expected to cover losses which have been growing since 1987. Similarly, the Spanish government is expected to foot the bill for public yard losses totalling around $1.6 billion for the period 1987 through 1990 [Ref. 34:p. 20].

c. Other Government Involvement.

In addition to the financial assistance provided to their domestic yards, foreign governments aid their industries

in other ways. Again the Japanese government provides the most assistance and direction as well as the most restrictions. Decisions on the tonnage to be built, the type of ships to build, the shipyards to get the contracts and the liner firms to get the new ships are all made by the Ministry of Transport (MOT) in consultation with the Shipping and Shipbuilding Rationalization Council [Ref. 19:p. 295]. This government involvement, with the advice of industry leaders, keeps Japan's shipping and shipbuilding industries strong. Government and industry cooperation resulted in the closure of 40 percent of Japan's yards in 1988 [Ref. 29:p. 134].

Cutting capacity to bring it into line with demand gave the remaining shipyards a better opportunity to remain healthy during the lean times. Reducing capacity also reduced the likelihood that the remaining shipyards would engage in cut-throat competition to the detriment of the industry as a whole. Since the severe shipbuilding depression of the 1980s, the Japanese government has not allowed medium-sized yards to build very large crude oil carriers although MOT has recently agreed to study the issue [Ref. 35:p. 4].

Another non-financial example of foreign governments assisting their domestic shipyards and other industries is the practice of tying foreign aid for capital projects to domestic goods and services. Japan, Germany, France, and Great Britain all provide about fifty percent of their foreign aid in the form of domestic goods and services.

Conversely, the United States only provides about eight percent [Ref. 31:p. 3].

D. U.S. INFLUENCES

Foreign competition is but one reason for the decline in U.S. shipyards. Domestic factors have also contributed to the decline in the areas of productivity, legislation, and the growth of Navy work during the worldwide shipyard decline in the 1980s.

1. PRODUCTIVITY

U.S. shipyard productivity in the commercial market has not kept pace with the major shipbuilding powers of Japan and Korea. The reasons for this failure are many. First, the Japanese and Korean yards began their rise to world class shipbuilders with cheap labor possessing a strong work ethic. As previously addressed, this low cost of labor gave the Japanese and Korean yards a distinct advantage in the world market due to the significant amount of direct labor hours that are required in the manufacture and assembly of merchant vessels. U.S. yards, on the other hand, faced rising labor costs as unions successfully negotiated more lucrative wage contracts backdropped against the rising U.S. standard of living.

The second reason that U.S. yards were unable to keep up with the Japanese and Korean yards' productivity is the support that these foreign yards received from governmental

sources that the U.S. yards did not receive in turn. Following the Second World War, the Japanese government targeted the merchant shipping industry as an area for intense government oversight. The extent of this strong government support can be seen in the loans provided by the Japan Development Bank during the period 1951 - 1972 where marine transportation constituted 31.5 percent of the total loans made [Ref. 19:p. 295]. Other governmental support to Japanese and South Korean yards has already been discussed.

Shipyard layout and age are a third reason for the lagging of U.S. productivity to foreign yards. While most foreign yards were rebuilt at the end of the Second World War, U.S. yards, with the exception of Pearl Harbor, were untouched by enemy action. Consequently, of the major shipyards in the U.S., one-third are over 100 years old and all but one exceeds 65 years of age [Ref. 12:p. 99]. Furthermore, the layout of these old yards does not lend itself to the modern manufacturing technique of modular construction. As a result, U.S. yards tend to employ lower levels of technology than do foreign yards. A 1983 Office of Technology Assessment report identified numerous shortfalls in U.S. shipyard productivity vis-a-vis Japanese and Korean shipyards. The OTA report notes weaknesses in:

> technological investment, research and development (R&D) investment, use of labor, tooling, degree of automation and use of robotics, and application of modern automated management and control techniques, as well as in the

methods of processing, joining, and assembly [Ref. 12: p.97].

Some of the disparity between U.S. and foreign shipyard productivity can be explained in terms of the amount of aid which each government provides to domestic shipyards. The governments of Japan, South Korea, and Germany have proposed or budgeted a combined total of over $12 billion in commercial shipbuilding-related aid since 1987. In comparison, the U.S. government has provided only $4.6 million -- its contribution to the National Shipbuilding Research Program [Ref. 36:p. 2]. Government aid in itself does not enhance productivity. However, financial aid can produce productivity improvement incentives depending on how the aid rules are written.

Despite the investment of over $4.6 billion in new plant and equipment since 1970, U.S. shipyards are still not competitive with either Japanese or Korean shipyards for commercial merchant ship builds[1]. Capital investment in the U.S. shipbuilding and repair industry for the period 1985 through 1991 is shown in Figure 8 [Ref. 16:p. 56].

With regard to the use of the yards, foreign shipyards, particularly those in Korea and Japan, have seen considerably more business than have the yards in the United

[1] Vice Admiral Hekman, Commander, Naval Sea Systems Command, stated in testimony before the House Armed Services Seapower and Strategic and Critical Materials Subcommittee in 1990 that U.S. shipyards could build warships cheaper than Japan [Ref. 20:p. 186].

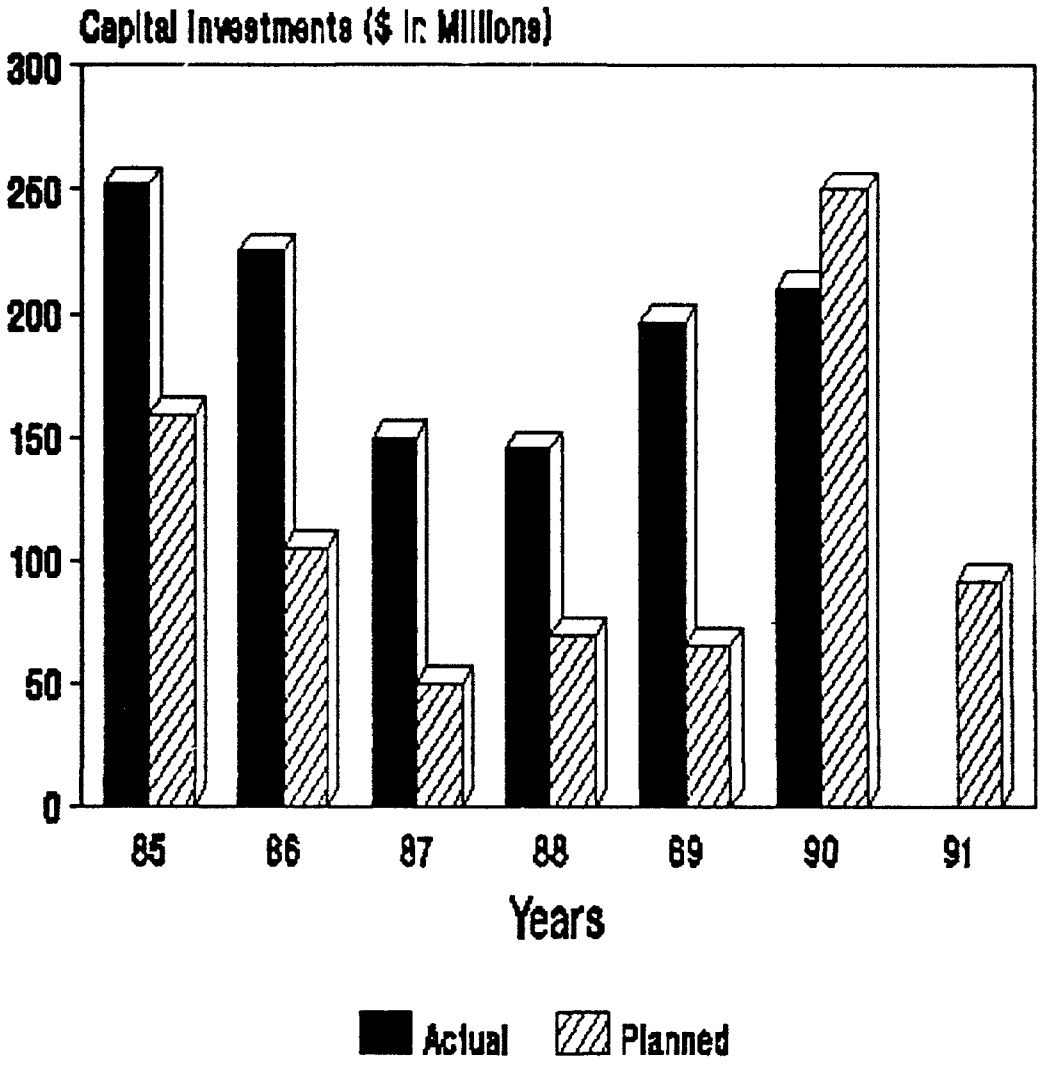

Figure 8. Capital Investments in the U.S. Shipbuilding and Repair Industry (1985 - 1991). [Ref. 16:p. 56]

States. This is attributable in part to the pursuit by these yards of markets that have the highest volume of ship demand [Ref. 12:p. 85]. A large business volume makes series production possible. In turn, series production means that learning curve gains are achievable, that technological processes can be perfected, that profits are being generated

to improve the shipyards' capability, and that the work force (labor and management) is keeping their basic skills honed and are presented with opportunities to improve their skills. Other advantages with consistently high volume work include the maintenance of the supplier industries with the resulting employment, labor skills, and strengthened industrial base[2].

In comparison to Korean and Japanese shipyards, U.S. shipyards have experienced a marked decline in commercial shipbuilding business. Japanese and Korean shipyards have climbed from 26.2 percent and 2.8 percent of the world commercial shipbuilding market (DWT) in 1978 to 38.3 percent and 17.6 percent, respectively in mid-1991 [Ref. 1:p. 1]. In comparison, U.S. shipyards went from 6.5 percent of world orders for commercial vessel tonnage in early 1978 [Ref. 21: p. 11] to only had seven-tenths of one percent by mid-1991 [Ref. 1:p. 1]. This lack of business has placed U.S. yards further behind the world competition as U.S. yards are reaping none of the aforementioned benefits of series production. It becomes increasingly more and more difficult for U.S. shipyards to compete in the world market when the competition can underbid U.S. quotes at virtually every opportunity.

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[2] These last two points, labor skills and the industrial base, are particularly critical in the construction of nuclear powered naval vessels [Ref. 20:pp. 163 & 306].

2. LEGISLATION

U.S. legislation has played a significant role in the present condition of American shipyards. Congress and the President have enacted legislation to both the benefit and the detriment of U.S. shipbuilders.

a. Beneficial Legislation

Beneficial legislation, from the perspective of the shipbuilders, provides business opportunities and protection from competition. The economic ramifications that this legislation has on U.S. shipowners, carriers, and shippers is beyond the scope of this paper. However, it must be noted that shipbuilding legislation does impact directly and indirectly on other industries within the United States. What is good for U.S. shipbuilders is not necessarily good for these other industries.

(1) Military Transport Act of 1904. Shipments in support of U.S. Armed Forces overseas must be carried on U.S.-flag ships pursuant to this act. Fifty percent of the military cargo covered by this Act is also impacted by the Cargo Preference Act in subparagraph (6) below. That is, Military Sealift Command cannot use Government owned or controlled vessels to ship more than 50 percent of its cargo [Ref. 12:p. 183].

(2) Jones Act of 1920. The Jones Act requires that ships in the domestic trades (coastwise, intercoastal, noncontiguous, and inland waterway trades) be built in U.S. shipyards and that the ships be under U.S. registry [Ref. 12: p. 76]. Domestic shipyard construction also applies to specialty vessels (dredges, towboats, salvaging vessels, hovercraft, and inflatable rafts) used in the domestic trades [Ref. 37:p. 28 and Ref. 38:p. 51]. Furthermore, rebuilt vessels over 500 gross tons participating in the domestic trades must have been rebuilt in U.S. shipyards [Ref. 37: p. 28]. Vessels under 500 gross tons may lose their right to participate in the domestic trades if they are re-built abroad or re-built in the United States using foreign material extensively [Ref. 38:p. 52].

(3) Tariff Act of 1930. This Act adds a 50 percent ad valorem tax on non-emergency repairs to U.S. owned ships outside of the United States and on imported equipment for boats, including fishing nets [Ref. 38:p. 51]. Basically, this Act is designed to protect the U.S. shipbuilding industry.

(4) Buy American Act (BAA). The Buy American Act was originally enacted in 1933 and is directed at restricting the public sector from procuring foreign goods or limiting the procurement of specific goods containing foreign labor or material based on content formulas [Ref. 38:pp. 29 -

30]. The BAA is incorporated into several U.S. maritime laws. For government subsidized ships, the Buy American Act mandates that at least 50 percent of the machinery and materials be of U.S. manufacture [Ref. 12:p. 108].

(5) Public Resolution 17. This legislation, enacted in 1934 [Ref. 38:p. 79], requires that 100 percent of U.S. Government generated cargoes, financed by Government loans to foster exports, must be carried on U.S.-flag ships [Ref. 12:p. 182]. U.S. Government loans refer to those made by the Export-Import Bank for exportation of U.S. goods [Ref. 39:p. 161].

(6) Cargo Preference Act of 1954. This act applies to U.S. Government impelled cargoes. Military cargoes must be shipped using government or privately owned U.S.-flag vessels [Ref. 14:p. 11], while at least 50 percent of other federal agency cargoes must be shipped in U.S. privately owned vessels [Ref. 12:p. 182] when they are available at fair and reasonable rates [Ref. 39:p. 161].

(7) Burnes-Tollifson Amendment. This 1964 change to Section 7309, Title 10, United States Code requires that U.S. Navy and Coast Guard vessels be built in U.S. shipyards, including small inflatable rafts and boats [Ref. 38:p. 25].

(8) Food Security Act of 1985. This act, when applicable, requires that 75 percent of shipments for the U.S. Department of Agriculture and the Agency for International Development (AID) be shipped on U.S.-flag ships [Ref. 37: p. 28]. Under this Act the Department of Agriculture was required to use one billion dollars worth of Commodity Credit Corporation stocks to subsidize exports of U.S. farm products. From FY 85 through FY 91, this Act impacted shipments totalling approximately 94.2 million tons of wheat, 3.1 million tons of wheat flour, and 10.3 million tons of feed grain [Ref. 38:p. 55].

(9) Trade Act of 1988. Section 301 of this act, commonly called Super 301, allowed the Executive branch to impose trade sanctions on foreign countries who participated in unfair trade practices. The Shipbuilders Council of America filed a grievance under this act in 1989 [Ref. 40: p. 82] to U.S. Trade Representative Carla Hills for shipyard subsidies being provided by West Germany, Japan, South Korea, and Norway [Ref. 41:p. 88].

(10) Oil Pollution Act of 1990. This act applies to oil tankers entering U.S. waters. The act, among other things, requires that tankers ordered after June 30, 1991 must have double hulls. Furthermore, existing tankers face a phase-out period based on gross tonnage and age such that all

single hull tankers must be replaced by the year 2010 [Ref.42: p. 26].

b. Detrimental Influences

Detrimental Federal executive and legislative action make it more difficult for U.S. shipbuilders to attract business. The following examples are indicative of legislation which has hurt U.S. shipbuilders.

(1) Construction Differential Subsidies. As previously described, CDS were a part of the Merchant Marine Act of 1936 and were intended to offset the higher cost of building merchant vessels in U.S. shipyards. Although the legal limit of 50 percent was not sufficient to cover the higher costs being experienced in the 1980s, the Secretary of Transportation stopped requesting CDS funding from Congress in FY 1982 [Ref. 12:p. 154]. This action eliminated an alternative available to U.S. ship buyers while, at the same time, no action was taken by foreign governments to stop their subsidy programs.

(2) Omnibus Budget Reconciliation Act of 1991. The Credit Reform Act portion of this bill requires the passing of authorizations and appropriations prior to government agencies guaranteeing private debt. Whether or not this act applies to Title XI financing has yet to be determined [Ref. 43:p. 1]. However, the act has already impacted U.S. shipyards in that the Crowley Maritime

Corporation withdrew its request for a $450 million Title XI mortgage guarantee when the Maritime Administration failed to act on the request prior to the Omnibus Act becoming effective on 1 October 1991 [Ref. 44:p. 3]. Crowley requested the Title XI guarantee to help finance ten new double hull tankers for use in the domestic trades [Ref. 45:p. 63].

(3) Super 301 Provision of the Trade Act of 1988. Although this was listed as beneficial legislation above, the Super 301 portion of the Act expired in 1990[3] [Ref. 46:p. 2F]. Consequently, U.S. industry has one less avenue of attack against governments who allow unfair barriers to foreign trade.

3. NAVY WORK GROWTH

While the shipbuilding industry was experiencing a drop in worldwide demand in the 1980s, the United States Navy was beginning its largest peacetime combat ship construction program in U.S. history as a result of the Reagan Administration's defense buildup [Ref. 1:p. 2]. This boom in naval construction provided extensive work to shipyards that would otherwise have found themselves in the throes of the worldwide shipbuilding depression of the 1980s. Figure 9 below depicts the number of new naval vessels placed on order with U.S. private shipyards from 1968 to 1990. Figure 10, on

[3] The Gephardt-Levin bill, introduced into the House on 4 November 1991, attempts to extend the Super 301 provision which expired [Ref. 46:p. 2F].

the other hand, illustrates the total Navy orderbook by showing the total number of new naval vessels under construction or on order at U.S. private shipyards from 1969 to 1991.

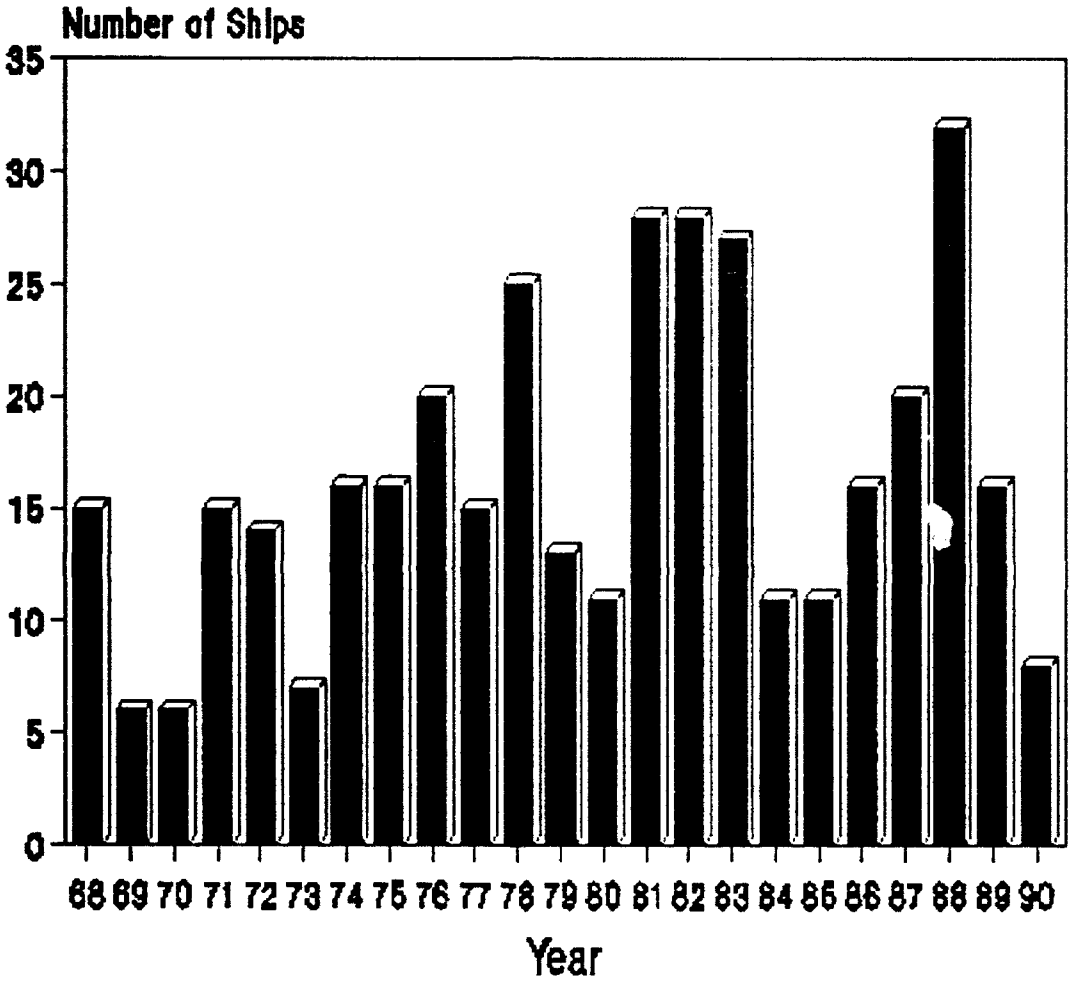

Figure 9. New Naval Vessels Ordered From U.S. Shipyards (1968 - 1990). [Ref. 15:p. 5]

The pace of new naval construction in the 1990s, however, will not approach the growth experienced during the last decade. During the Cold War, the Reagan Administration

was supporting the development of a 600 ship Navy. More recently, General Colin Powell, Chairman of the Joint Chiefs

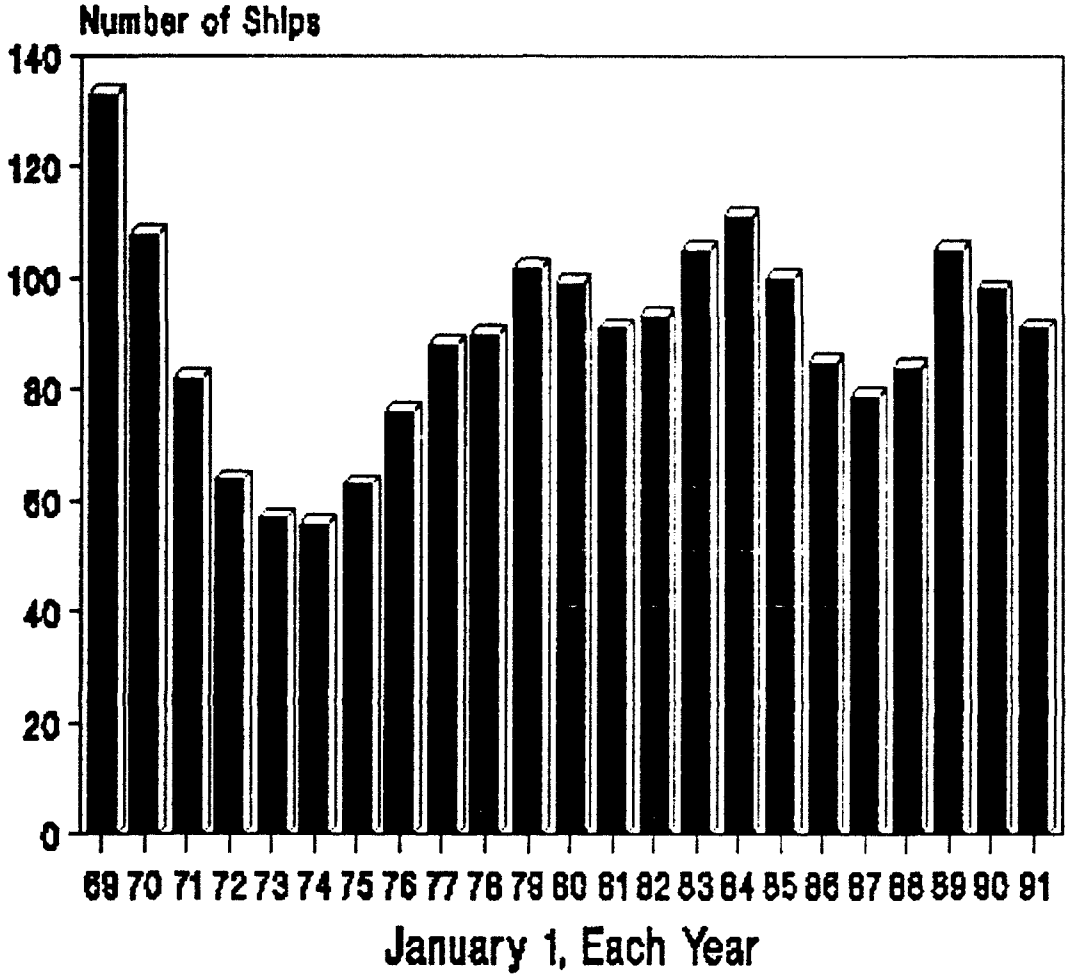

Figure 10. Total Naval Vessels Under Construction or On Order at U.S. Shipyards (1969 - 1991). [Ref. 15:p. 5]

of Staff, testified before the House Appropriations Subcommittee on Defense on 24 September 1991 that the Office of the Secretary of Defense has set the Navy's active ship goal at 414 ships by 1997 [Ref. 47:p. 3]. This is a reduction of an additional 34 ships from the number set forth in the

Department of Defense's FY 1992 budget request. The FY 1992 budget request had indicated a decline from 545 to 450 by 1995 [Ref. 48:p. 28]. With this expressed policy, it is apparent that the end of the Cold War rivalry and the mounting deficit problems of the United States Government are dictating a reappraisal of national defense strategy.

In line with this new reality is the Navy's proposed shipbuilding budget for FY 92 through FY 97. This budget calls for the construction of 68 ships or approximately ten ships per year. The FY 92 - 97 annual construction average is roughly fifty percent of the average annual naval construction experienced during the 1980s. The Navy's shipbuilding plan for FY 92 through FY 97 is shown in Appendix B.

The decline in naval ship construction and repair work will have a marked effect on the U.S. shipbuilding industry in terms of employment and the industrial base. According to the Assistant Secretary of the Navy for Research, Development and Acquisition, Gerald A. Cann, Navy work accounts for approximately 97 percent of the active U.S. shipbuilding base's direct construction labor and 50 percent of the ship repair labor [Ref. 20:p. 286]. This employment support has been present for the past several years. Adding to the impact of the declining budget is the fact that approximately 90 percent of the Navy's shipbuilding funds have been under contracts awarded to only five private yards. Those yards are: Avondale, Bath Iron works, General Dynamics/Electric

Boat, Ingalls, and Newport News Shipbuilding [Ref. 1:p. 2]. This concentration of naval construction (employment and dollars) in a few private shipyards means that they will be hard hit by the decline in Navy orders.

Once employment levels at these shipyards drop, it is unlikely that the shipyards will be successful in attracting the workers back, even if industry conditions improve. Shipyards have found it increasingly difficult to attract and to retain skilled workers in the shipbuilding industry when job security is all but nonexistent. If laid-off workers are able to find stable and/or lucrative employment outside of the shipbuilding industry, there would be little incentive to return to building ships when the market for shipbuilding improves [Ref. 11:p. 59]. The good times would only last until the next industry-wide downturn. Figure 11 illustrates the U.S. shipbuilding firm swings from 1982 through 1990, while Figure 12 shows employment level projections in the active shipbuilding industry [Ref. 1:figure 22-2]. The figure shows total employment, employment based on projected new construction, employment based on contracted new construction, and employment based on repair and non-ship work.

Exacerbating employment levels in the U.S. shipbuilding industry is the Navy's Reliability and Improvement Program for the fleet. This program is greatly improving the reliability and maintainability of weapons platforms. New vessels equipped with gas turbine and diesel

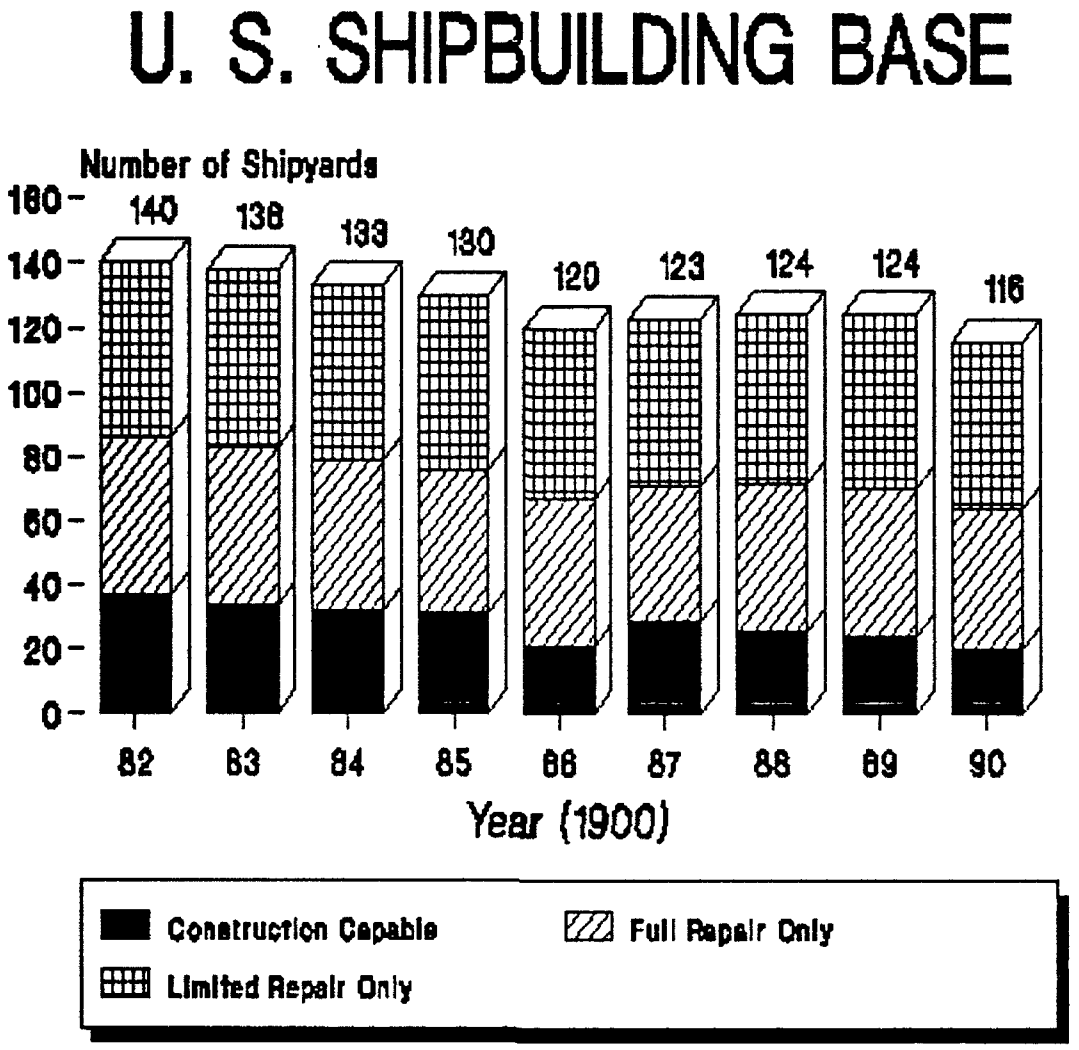

Figure 11. U.S. Shipbuilding Base (1982 - 1990). [Ref. 49: p. 300]

power plants require less maintenance than the old steam propulsion plants [Ref. 50:p. 2].

In 1990, 60 percent of the Navy's surface combatants were steam driven while only 22 percent were gas turbine. By 2009, the percentage of steam and gas turbine plants is expected to be 12 percent and 88 percent, respectively

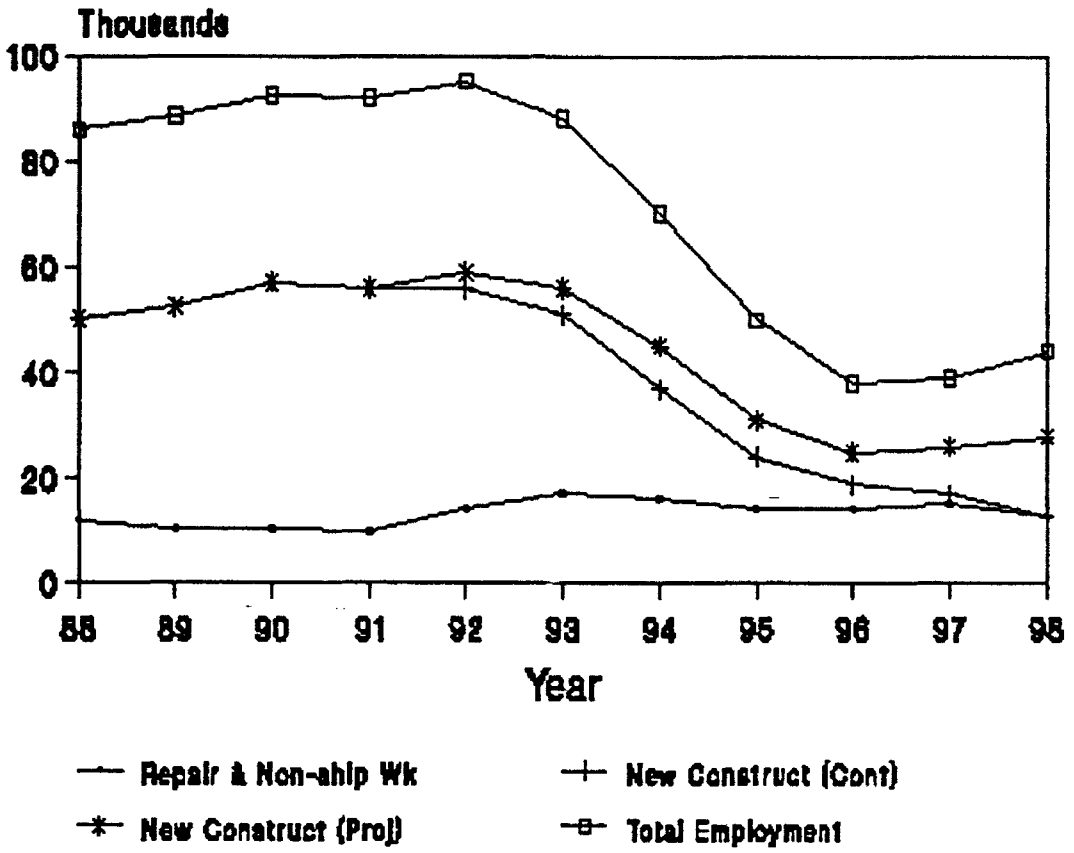

Figure 12. Active Shipbuilding Base Labor Projection on October 1, 1991. [Ref. 1:fig. 22-2]

[Ref. 20:p. 396]. When major failures or overhauls are required for the gas turbine systems, removal and installation takes at most four to five days, a considerable improvement over similar service requirements for steam plants [Ref. 20: p. 396]. A smaller Navy possessing more reliable ships means less repair and overhaul work for U.S. shipyards. In February 1991, the Shipbuilders Council of America (SCA) projected that

shipyard maintenance mandays would drop 33 percent below FY 90 levels by FY 1997 [Ref. 50:p. 2]. By February 1992, the SCA revised their reduction projection to 1995 [Ref. 51:p. 2]. The 1995 timeframe was also reported in the Marine Log [Ref. 52:p. 14].

The Navy's Maintenance and Modernization Program is also impacting U.S. shipyard employment levels in other ways. As a result of changes in ship overhaul policies, major overhauls are now more spread out than they once were. Whereas overhauls used to be scheduled every three to five years for naval vessels, ships may now go up to twelve years between overhauls. As a comparison, 90 ships went through major overhaul in FY 1977 whereas only 13 are planned for overhaul in FY 1991 [Ref. 20:p. 285]. Although major overhaul intervals were expanded by increasing the number of smaller repair availabilities for active naval ships, drydock-phased maintenance availabilities, drydock-selected restricted availabilities, phased maintenance availabilities, post-shakedown availabilities, and selected restricted availabilities are much smaller in scope than are major overhauls. Consequently, these availabilities require a smaller standing work force [Ref. 20:p. 391 and Ref. 53:p. 3].

The decline in the number of active Navy ships will also impact the industrial base. The supplier base is sure to shrink as a result of the drop in new ship builds and the decline in the size of the active fleet. Over the past

decade, the number of U.S. vendors for key ship components has dropped. This trend is projected to continue into the future as illustrated in Figure 13 below.

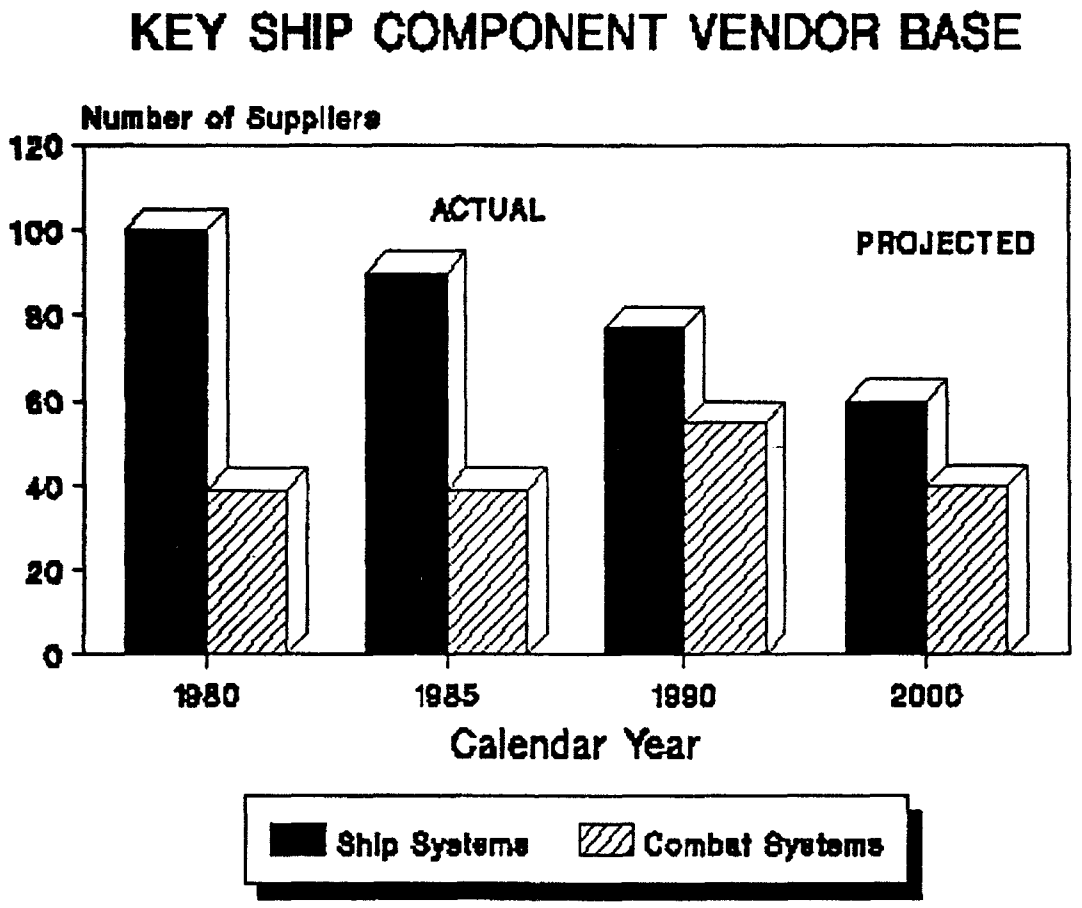

Figure 13. U.S. Vendor Base for Key Ship Components. [Ref. 1:fig. 8]

American shipbuilders will find it increasingly more difficult to find domestic sources of supply as the vendor

base gets smaller[4]. Donald T. Atwood, Deputy Secretary of Defense, has directed the Navy to study how the nuclear industrial base can be maintained given the smaller number of nuclear ships scheduled for construction [Ref. 55:p. 21].

As the domestic industrial base contracts, procurements from foreign sources will grow. The U.S. Navy already relies on several foreign countries for a number of standard Navy systems, as previously illustrated in Table 2. A shrinking industrial base means the United States will become less and less able to meet defensive needs independently.

[4] Admiral Bruce Demars, Director, Naval Nuclear Propulsion, testified before the House Committee on Armed Services Seapower and Strategic and Critical Materials Subcommittee and the Department of Energy Defense Nuclear Facilities Panel in April 1991 that the nuclear industrial base is being crippled with the reduction in nuclear ship construction. Currently there is only one remaining manufacturer in the business of making nuclear cores, one remaining for fuel, one remaining for reactor cooling pumps, and two remaining for fuel rod drive mechanisms. In addition, he is seeing a rapid exodus of subcontractors from the field [Ref. 54:pp. 3 - 12].

IV. PROSPECTS FOR RELIEF

U.S. shipbuilders have numerous opportunities to improve their competitiveness within the world shipbuilding arena. Some of these opportunities include: world-wide replacement tonnage demand, double hull legislation for oil tankers servicing the U.S., fast sealift needs identified as a result of Desert Shield and Desert Storm, and foreign military sales. Additional avenues for future growth involve the cooperation of the U.S. Government in the areas of foreign policy, subsidies, and domestic policy. This chapter will focus on these opportunities and will also summarize some of the recent studies that address the condition and the capacity of U.S. shipyards, primarily in terms of national defense.

A. SHIPBUILDING MARKET DEMAND

Market demand for new ships is perhaps the greatest target of opportunity for U.S. shipyards breaking out of their reliance on Navy shipbuilding orders. Projections for ship orders are encouraging with most of the strength coming from replacement rather than expansion demand [Ref. 15:p. 25]. The Korean Shipbuilders Association [Ref. 56:p. 2] and the Institute of Shipping Economics and Logistics both predict that demand will reach approximately 30 million deadweight tons per year [Ref. 53:p. 60]. This demand presents a ready

opportunity for U.S. shipyards to regain a competitive position in the commercial shipbuilding market before the drop in Navy orders hits with full impact. Figure 14 below shows the type of demand that is being predicted.

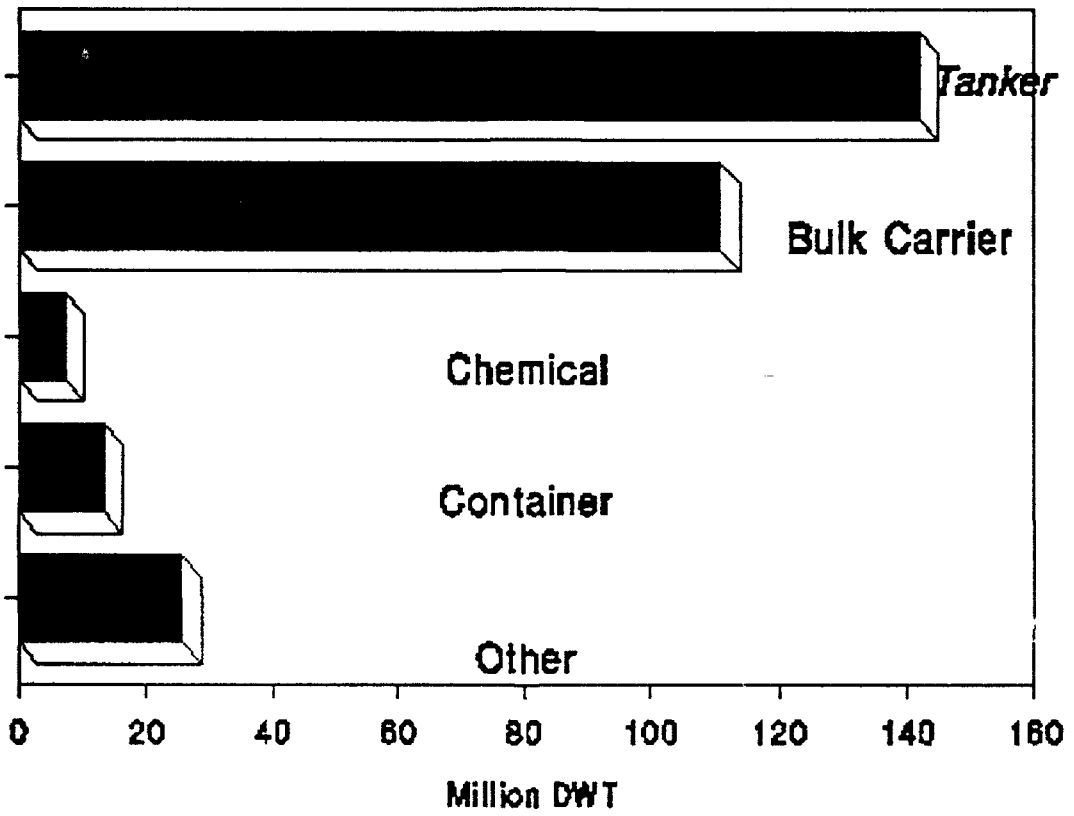

Figure 14. Projected Shipbuilding Demand (1990 - 2000). [Ref. 57:p. 60]

The replacement demand reflects the age and condition of the world's tonnage [Ref. 15:p. 25]. As ships get older, they become less efficient and more costly to maintain and operate. Figure 15 shows the percentage of world tonnage over fifteen years old.

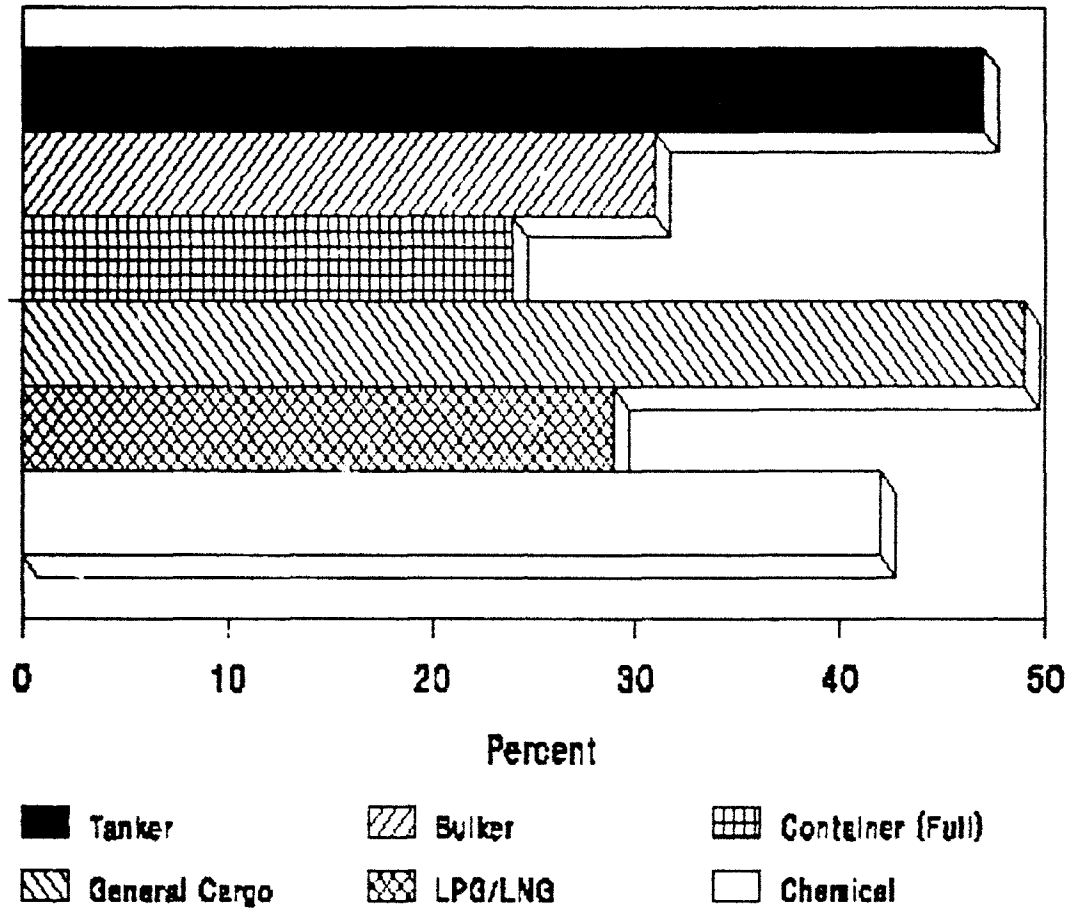

Figure 15. Percent of World Tonnage Over 15 Years Old (End of 1990). [Ref. 15:p. 25]

B. DOUBLE HULL TANKERS

The Oil Pollution Act (OPA 90) was signed into law in August 1990 [Ref. 58:p. 2]. For U.S. shipbuilders, this legislation represents a source for domestic, commercial tanker orders. Sixty percent (68 out of 150) of the tankers operating under Jones Act trade are greater than twenty years

old [Ref. 59:p. 1]. To serve U.S. ports, tankers ordered after June 30, 1990 must have double hulls. Beginning in 1995, existing single hull and older double-hulled tankers will be phased out according to the schedule shown in Table 6.

TABLE 6. PHASE-OUT SCHEDULE FOR SINGLE HULL AND OLDER DOUBLE HULL TANKERS SERVING U.S. PORTS (IN YEARS).

Gross Tons (000s)	Hull Type: S = Single D = Double	Years 1995	2000	2005
30+	S	≥28	≥23	
	D	≥33	≥28	
15 - 30	S	≥40	≥30	≥25
	D	≥45	≥35	≥30
5 - 15	S	≥40	≥35	≥25
	D	≥45	≥40	≥30

[Ref. 42:p. 26]

Single hull ships in all three categories must be phased out by the year 2010. Older double hull ships have until 2015. Lightering vessels transferring oil more than 60 miles offshore, ships less than 5,000 GT, and vessels operating in the Louisiana Offshore Oil Port have until 2015 to comply with the requirements of OPA [Ref. 42:p. 26].

C. SEALIFT PROGRAM

With the collapse of the former Soviet Union, future conflicts involving U.S. military personnel will probably be of the type seen in Desert Shield and Desert Storm. The Gulf War saw approximately three billion tons of dry cargo and 5.4

billion tons of petroleum products moved on over 250 MSC controlled ships [Ref. 60:p. 52]. The shift away from global warfare to regional warfare lends itself to a re-examination of the sealift capability required to successfully prosecute such a conflict while ensuring that U.S. national defense needs are met.

The lessons from Desert Shield and Desert Storm provide yet another opportunity for U.S. shipbuilders. The Gulf War demonstrated once again the need for sealift in meeting military commitments around the world. Although adequate sealift capability was obtained to support the Gulf War effort, 101 of the 120 chartered ships were of foreign registry [Ref. 60:p. 53]. The mobilization effort also identified weaknesses in the Ready Reserve Force (RRF) and National Defense Reserve Fleet (NDRF) in terms of material condition and the availability of spare parts [Ref. 60:p. 53].

To correct some of the sealift shortfalls identified, the Navy is looking at procuring as many as 25 sealift ships in an effort to acquire an additional 1.2 million square feet of lift capability. Congress has already appropriated $1.275 billion for this purpose in FYs 1990 and 1991 [Ref. 61:p. 2]. U.S. shipyards participating in this Sealift Program can potentially get a jump start into the commercial shipbuilding market, assuming the sealift ships are close in design to commercially operated vessels.

One recent proposal is aimed at meeting this goal by designing ships useful for both defense and commercial purposes. The features of the proposed ships include: the same basic hull design, ship control systems, and propulsion plants [Ref. 62:p. 39]. The ships' cargo sections, however, would vary in length and design depending on lift requirements.

Ships envisioned under this program include: convertible container carriers (CCC), combination breakbulk and containership (COMBO), a heavy-lift model, and a heavy RO/RO. The designs would stress the minimal number of defense features so as not to detract from their commercial usefulness. A building program could then be initiated to fulfill defense and commercial needs with economies of scale, and resulting savings, achievable using series building [Ref. 62:p. 39].

The ships designed for commercial use could either be sold or leased to commercial operators. The ships designed solely for defense could be added to the Military Sealift Command's Maritime Prepositioning Ships or Fast Sealift Ships, or the ships could be used to augment the Ready Reserve Force or the Afloat Prepositioning Force. Ships of mutually useful design, like the ones envisioned, can foster closer relationships between shipowners, shipbuilders, and the Department of Defense. Modern ships capable of meeting DOD and commercial

requirements make a build and charter program a worthwhile goal to pursue.

D. FOREIGN MILITARY SALES

Foreign military sales (FMS) are another potential avenue for U.S. shipbuilders to rebound from the decline in Navy business. In addition to helping the balance of trade with vessel sales and follow-on repair parts, exports would also help to sustain America's industrial capability and labor skills.

Submarine-capable shipyards and their suppliers are already facing a bleak future which could be improved with exports. In 1991 the Navy stated that two Seawolf-class, or SSN 21-class, submarines per year would be required to keep both Electric Boat and Newport News in business [Ref. 60: p. 56]. In January 1992, the President decided to terminate the Seawolf Program after the completion of the first of the class [Ref. 63:p. 3G]. The future of the two yards is now in question.

The decline in Navy business has a trickle down effect on shipyard suppliers. Following cancellation of the Seawolf program, General Dynamics Electric Boat decided to lay off 1,000 to 2,000 personnel by the end of 1992 [Ref. 64:p. 1]. At the subcontractor level, 250 employees from Westinghouse Electric Corporation's Marine Division were permanently laid-off as a result of the Seawolf program's termination. The

Marine Division held part of a subcontract to build the Seawolf's propulsion gears [Ref. 63:p. 3G].

Arguments against exports of submarines usually include the proliferation of U.S. high technology [Ref. 23:p. 40] and the lack of diesel submarine requirements in the U.S. Navy [Ref. 65:p. 2]. To prevent high technology transfer, exports could be restricted to diesel submarines. Although the shift from nuclear to diesel power would require modifications to exporting shipyards, production of diesel powered submarines is seen by U.S. shipyards as preferable to going out of business. An added benefit in this scenario is the retention of submarine-building industrial base capabilities as well as the associated labor skills [Ref. 53:p. 2]. It is reasonable to assume that diesel submarine labor is more readily diverted to nuclear work than is reconstituting a disbanded nuclear submarine work force.

To overcome consistent Navy opposition to submarine exports [Ref. 60:p. 40], U.S. shipbuilders were successful in lobbying to get language approved in the House Armed Service Committee's FY 1992 defense appropriations bill. H.R. 2521 prohibits the Military Services from taking action to:

> prohibit, impede, or otherwise interfere with construction of conventionally powered submarines by nonpublic owned and operated ship construction and repair entities in the United States for sale to nations with which the United States maintains bilateral or multilateral mutual security agreements, or nations which currently receive foreign military sales credits or economic support funds from the United States [Ref. 65:p. 2].

E. U.S. GOVERNMENT INVOLVEMENT

To assist U.S. shipyards in getting re-established in the world commercial shipbuilding market, the U.S. government could take action in several areas (i.e., foreign and domestic policy).

1. FOREIGN POLICY

In the foreign arena, the U.S government could take action: to encourage foreign governments to stop subsidizing their domestic shipbuilding industries, to require greater use of foreign aid in the form of U.S. services rather than money, and to foster joint ventures with foreign firms in fields deemed to have critical commercial shipbuilding technology.

a. FOREIGN SUBSIDIES

The Shipbuilder's Council of America (SCA) has been fighting for years to get the U.S. Government to pressure foreign governments to stop subsidizing their domestic shipbuilding industries. The SCA's position is that the U.S. Government stopped subsidizing U.S. shipyards in 1982 when Construction Differential Subsidies were ended [Ref. 34:p. 1]. To make the world shipbuilding playing field level, the SCA feels that foreign shipbuilding subsidies should be terminated as well. Otherwise, foreign builders have a distinct advantage over U.S. shipyards that can never be overcome. The U.S. Government can bring pressure to bear using the General Agreement on Tariffs and Trade (GATT) as the vehicle.

However, the government lacks the political will to do so. Perhaps this is due to the fact that shipbuilding has never been a significant player in the U.S. economy [Ref. 8:p. 4].

b. FOREIGN AID TIED TO DOMESTIC SERVICES

To assist domestic shipyards, the U.S. government could tie greater amounts of foreign aid to domestic services rather than providing outright grants of cash. In this vein, commercial shipping needs of aid-receiving countries could be provided in the form of U.S. built ships. These ships could be new or trade-ins from U.S.-flag shipowners who would be given credit for new construction from U.S. shipyards. This alternative provides business to U.S. shipyards, encourages modernization of the U.S.-flag fleet, and builds replacement parts demand for U.S. suppliers, thus strengthening the balance of trade as well as the supplier base.

c. JOINT VENTURES

In critical technology areas for commercial merchant shipbuilding, the U.S. Government could provide financial incentives for domestic firms to form joint ventures with foreign corporations possessing the critical technology. Alternatively, the government could ensure that bureaucratic red tape for forming joint ventures is kept to a minimum. The thrust here is to get the maritime technology into the hands of the U.S. shipyards so that they can overcome their extended absence from the commercial shipbuilding market.

The advantages of joint ventures can be seen in the relationship between Avondale Industries, Inc., German shipbroker, Peter Gast Shipping, and Norway's Interyards. These three firms formed a company whose purpose is to enable the three participants to put together and jointly market highly competitive ship equipment packages. For Avondale, the joint venture means greater competitive capability in the commercial shipbuilding market in addition to access to a strong international supplier base. [Ref. 67:p. 1].

Similar advantages can be seen between Westinghouse Marine Division and New Sulzer Diesel Ltd. wherein Westinghouse will market and manufacture slow- and medium-speed diesel powered marine propulsion systems [Ref. 68:p. 4]. This joint venture brings needed commercial shipbuilding technology to a U.S. manufacturer. In turn, domestic capability and skilled labor are fostered, enhancing the industrial base of the nation.

2. DOMESTIC POLICY

Issues for the government to address under domestic policy to encourage the growth of U.S. shipyards in the commercial market include: subsidies, research and development, and rationalizing America's shipyards.

a. SUBSIDIES.

In the area of subsidies, the U.S. government could re-address such issues as: capital investment incentives for sealift modernization and export financing.

(1) Capital Investment Incentives. Capital investment incentives initiated by the U.S. government would be geared towards the modernization of the U.S. flag fleet. U.S. dry bulk vessels, in particular, are some on the oldest ships in the U.S. inventory [Ref. 12:p. 75]. Modernization would bring commercial business to U.S. shipyards as well as improve the competitiveness of shipowners in their respective trades.

The capital investment system envisioned includes both financial and non-financial incentives. Financial incentives include construction credits when old U.S.-flag ships are retired. Non-financial incentives include modernizing the archaic U.S. shipping laws and manning rules to allow shipowners to take full advantage of the latest technology available to them, which facilitates reduced operating costs [Ref. 60:p. 53].

(2) Export Financing. Export financing could be used by the U.S. government as a tool to encourage foreign governments to stop the practice. For argument's sake, given the condition of the U.S. economy, the U.S. could use its financial leverage to force government subsidies into a state

of bankruptcy. Although tantamount to a trade war, the practice would drive home the point that subsidies always hurt someone. To stop the hurt, stop the subsidies. This alternative is unlikely given the present financial weakness of the U.S. Government and the small impact U.S. shipbuilding has on the nation's economy.

b. RESEARCH AND DEVELOPMENT (R&D)

The U.S. shipbuilding industry has been noted for its lack of coordination within the industry [Ref. 12:p. 111] and its inability to share information among its members [Ref. 2:p. 17]. A concerted and coordinated research and development effort can assist in overcoming these problems through government involvement. U.S. shipbuilders have concentrated on naval technology over the past decade rather than commercial shipbuilding designs. Government incentives could be established which encourage commercial shipbuilding R&D as well as improve the flow of information within the industry. Under a centralized R&D program, U.S. shipbuilders would be encouraged to focus their attention on the commercial field and would be acclimated to sharing industry information.

Currently the government is only providing R&D assistance to the National Shipbuilding Research Program (NSRP). From 1987 through 1990, this assistance totalled only $4.6 million [Ref. 36:p. 2]. In comparison, for 1987 and 1988 alone, Japan, Germany, and South Korea provided a combined R&D

funding total in excess of $78.8 million [Ref. 30:p. 1]. It is unlikely that U.S. shipyards will gain a strong competitive advantage in commercial shipbuilding without additional U.S. Government assistance in the area of R&D.

c. RATIONALIZING U.S. SHIPYARDS

To promote a strong shipyard industry, the U.S. Government could take steps which would rationalize U.S. shipbuilding capability. Like Japan, rationalizing shipyards could require the closure of weaker companies. The remaining yards would then have the workload to keep them healthy. Closing private shipyards would be difficult for the U.S. Government unless the weaker yards were enticed out of the business. Even if the industry was nationalized, the pork barrel politics so well known in government would most likely produce inefficient results.

F. FORMAL STUDIES

Several formal studies have been made concerning the condition of U.S. shipyards and their ability to meet national defense needs. These studies include: the Shipyard Mobilization Base (SYMBA) Study, the National Defense Shipyard Study (NADES), the National Advisory Committee on Oceans and Atmosphere (NACOA), the Mobility Requirements Study (MRS), and the Navy's Strategic Sealift Implementation Plan. One of the newest formal studies is the Infrastructure Study in Shipbuilding (ISIS). ISIS' focus is on commercial

shipbuilding processes in the United States rather than on defense needs. A brief summary of each of these studies is presented below:

1. Shipyard Mobilization Base (SYMBA) Study

The purpose of the SYMBA study was to determine whether or not the U.S. shipbuilding base in existence in October 1982 was adequate for meeting major mobilization requirements in a three-year global war scenario. Specifically, the conflict envisioned was a "global, non-nuclear, three-theater, 3-year conflict" [Ref. 14:p. 42]. The study, completed in 1984, was conducted jointly by the Department of Defense and the Maritime Administration, concluded:

- Minimum first year facilities requirements include 51 building positions, 41 graving docks, and 56 floating drydocks.
- October 1982 shipyard capacity was more than adequate.
- Shortages in skilled manpower were expected during the early mobilization and the wartime ship construction phases. [Ref. 14:p. ix].

2. National Defense Shipyard (NADES) Study

The NADES study was conducted after 16 of the 110 private shipyards in the SYMBA study had closed prior to SYMBA's completion in 1984 [Ref. 11:p. 55]. Between October 1982 and June 1985, 20 of the SYMBA shipyards had closed either temporarily or permanently [Ref. 14:p. 43]. The NADES

study, like SYMBA, was a joint DOD - MARAD project completed in 1984.

NADES, however, used different criteria than the SYMBA study for determining the adequacy of the U.S. shipbuilding base in meeting major mobilization requirements. Specifically, NADES only reassessed the first eight months of mobilization and it focused on just 66 shipyards (9 public and 56 private) [Ref. 14:p. 43]. Assumptions about early mobilization and greater sealift requirements were also differences between the two studies [Ref. 14:p. ix]. Among other things, NADES concluded the following:

- Early mobilization requirements necessitated the availability of 142,000 skilled workers.
- Skilled workforce requirements would peak in the eighth month of the conflict at 157,000.
- Peacetime employment, including projected 1990 workforce levels, were adequate. [Ref. 14:p. ix].

3. National Advisory Committee on Oceans and Atmosphere (NACOA)

The NACOA study of 1985 followed both SYMBA and NADES. The NACOA study had three objectives. First, determine the most effective and efficient method for achieving adequate wartime sealift capability. Second, determine the shipyard base required to support mobilization, construction, and

repair requirements. Third, determine levels and types of Federal support necessary to achieve the other two objectives [Ref. 14:p. vii]. The NACOA concluded that a strong U.S.-flag fleet is more important for achieving wartime sealift capability than is a strong U.S. shipbuilding industry. A strong U.S.-flag fleet will provide the necessary sealift capacity at the start of a conflict as well as the trained crews essential for maritime endeavors. Some of the NACOA's recommendations to this end included:

- researching and stressing military useful features on U.S.-flag vessels.
- allowing U.S. operators to buy ships built in foreign shipyards (including provisions for Jones Act trade).
- providing incentives for foreign flag vessels to become U.S.-flagged [Ref. 14:pp. 72 - 75].

With regard to shipyards, the NACOA study concluded that peacetime military shipbuilding, conversion, and repair programs would ensure an adequate mobilization base [Ref. 14: p. 72].

4. Mobility Requirements Study (MRS)

The DOD has determined strategic sealift requirements through its Mobility Requirements Study which was completed in January 1992. Based on the need for sealift under a broad spectrum of scenarios, the MRS has determined the size, mix,

number, and employment of sealift ships" necessary to meet national requirements [Ref. 69:p. 2].

Among other things, the MRS calls for twenty large, medium speed RO/ROs from either reconversions or new construction. Eleven of these RO/ROs are to be assigned to Fast Sealift with the other nine prepositioned. Additionally, the MRS calls for the lease of two container ships which also will be prepositioned. The delivery schedule projects 6 ships in FYs 94, 96, and 97, and 4 ships in FY 98. Finally, the MRS supports the growth of the RRF from its current 96 ships to 142 ships [Ref. 70:p. 5].

5. Navy's Strategic Sealift Implementation Plan

The Navy's Strategic Sealift Implementation Plan documents how the Navy proposes to use the FY 90 and FY 91 sealift appropriations of $1.275 billion and $1.3 billion, respectively. This plan was submitted to the House Appropriations Committee per the Committee's request. The plan used the Navy's Interim Response to the MRS of April 22, 1991, and was later incorporated into the MRS Final Report [Ref. 69:p. 2].

One of the Strategic Sealift Implementation Plan's recommendations is the initiation of the concept design for two types of roll-on/roll-off (ro/ro) ships. To date, nine contracts have been let by the Navy to U.S. shipyards for the

development of conceptual designs for the 750-foot and 900-foot length ships [Ref. 69:p. 2].

6. Infrastructure Study in Shipbuilding: A Systems Analysis of U.S. Commercial Shipbuilding Practices

The ISIS study of 1991 was performed by a team at the David Taylor Research Center. The purpose of the study was to examine the U.S. commercial shipbuilding practices, using a systems approach. The study's aim was to focus on the acquisition process, in particular, in order to identify alternatives that would assist U.S. shipbuilders in becoming world-class competitors in the commercial shipbuilding market. Some of the study's more significant conclusions include:

- information sharing within the U.S. shipbuilding industry is a problem.
- shipbuilders have no domestic source capable of analyzing the world shipbuilding market and matching market needs to U.S. shipbuilder capabilities.
- shipbuilders need to be proactive in controlling, documenting, and monitoring the acquisition process rather than reacting to their customers.
- shipbuilders need to develop financial acumen in acquiring private capital to finance new shipbuilding. Financing should become a part of the package being sold to the customer.
- shipbuilders need to develop the ability to forecast and analyze market needs so that ships can be designed and sold to the customer. The customer defines requirements under current practice without any forethought on the part of the shipyard.
- shipbuilders need to develop industry design and material standards to improve material procurement and production leadtimes. [Ref. 2:pp. 17 - 18]

The ISIS study concludes that the U.S. is in danger of losing its commercial shipbuilding capability to foreign shipbuilders. Although the study encourages action to rebuild the U.S. commercial shipbuilding industry, it does not make any recommendations directed towards that aim.

The avenues above provide potential sources of new business for American shipyards. Like all commercial entities, U.S. shipyards must maintain a customer base that is willing to buy shipbuilding and ship repair services at a price that covers their cost of production and a reasonable profit. Furthermore, shipyards must be able to provide the product in a timeframe which meets the customer's requirements. The alternatives to these precepts are for American shipyards to concentrate on repair work only, change industries, or to go out of business entirely. The next chapter provides the summary, conclusions, and recommendations.

V. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

A. SUMMARY

Chapter II provided an overview of shipbuilding. Topics addressed included the growth of the U.S. shipbuilding industry, the complexity of the shipbuilding process, the capital and labor requirements that make the shipbuilding industry unique, and the national defense issues associated with shipbuilding capability. Chapter II further described the uncompetitiveness of U.S. shipyards, their shift from commercial to Navy work, the growth of repair and specialty work over construction, and the competition between private and public shipyards for repair and modernization work.

Chapter III covered the principal reasons for the decline of U.S. shipyards. Overcapacity, the cyclic nature of the industry, foreign competition, and U.S. influences were discussed in detail.

Finally, Chapter IV described some avenues that U.S. shipyards can pursue to strengthen their position in the international commercial merchant shipbuilding market. Areas of potential growth include the projected worldwide demand for vessel tonnage, double hull tankers, the Navy's Sealift Program, foreign military sales, and active U.S. Government

involvement. What follows are the conclusions and recommendations drawn from the data presented in this thesis.

B. CONCLUSIONS

With possibly three exceptions (the Clipper Era, and the First and Second World Wars), the U.S. shipbuilding industry has never been a dominant supplier of the world's commercial vessels. Typically the percentage of world merchant orders filled by U.S. yards averages in the single digits.

Following the Second World War, the volume of military cargo ships sold to civilian entities glutted the market and required additional adjustments in the industry as it moved from a wartime to a peacetime posture. The Korean and Vietnam Wars did little to spur new construction in the United States. The war buildups were taken care of by existing assets in the NDRF, RRF, or commercial market and did not require a tremendous addition to the U.S. sealift capacity to prosecute the wars.

In the 1960s and early 1970s, U.S. shipbuilders allowed the Japanese to master the shipbuilding processes (i.e., modular production, financing, and shorter construction times) which would make them the undisputed world leaders in commercial shipbuilding. The Japanese successfully developed their market and have been reaping the benefits ever since (i.e., learning new processes, keeping workforce skill levels high, maintaining their industrial base and second tier

suppliers, and earning profits to maintain and modernize facilities).

In the early 1980s the Executive Branch of the U.S. Government terminated Construction Differential Subsidies. As U.S. labor costs were significantly higher than the foreign competition, particularly Korea and Japan, and as foreign governments did not withdraw similar subsidies from their own shipbuilding industries at the same time, the elimination of CDS further eroded the competitiveness of U.S. yards in the world commercial shipbuilding market. The number of commercial merchant vessels built in the U.S. has since declined consistently, finally hitting zero in 1988 through 1990.

Despite this persistent drop in commercial builds in the 1980s, U.S. shipyards benefitted from the largest peacetime naval build-up in U.S. history. Navy contracts made up for the loss of commercial orders and ultimately accounted for approximately 95 percent of the ship repair, modernization, and construction work at the biggest five shipyards in the United States.

This naval buildup has peaked and the pendulum is now reversing its swing. U.S. shipyards are currently facing an environment where they have been out of the commercial market for years. At the same time, their primary customer for the past decade is significantly reducing the amount of work previously supplied. Areas of work reduction cut across the

spectrum, and they include new construction, modernization, and maintenance of the active fleet.

Exacerbating the predicament of U.S. shipyards are the technological and philosophical changes which the Navy implemented over the course of the buildup. A change from steam to gas turbine and diesel power plants has greatly reduced the number of maintenance man-days required to keep these systems operational. The Reliability Improvement Program has also lowered the number of maintenance man-hours in other areas as failure rates have declined. Consequently, shipyards are getting less work per Navy ship than they did in the 1980s and earlier.

Given the projected loss of work at the big five shipyards and the absence of new commercial orders to replace that work, U.S. shipbuilding capacity will exceed demand once again. As in the past, those shipyards unable to attract a profitable level of business will cease to exist. This will probably be the case for the General Dynamics Electric Boat Division, given the cancellation of the Seawolf program and the prospect that there will not be enough submarine business in the foreseeable future to support both Electric Boat and Newport News. Another of the big five may also leave the ship construction business as the level of Navy work reduces to a point below the minimum support level required to keep the yards profitably employed.

The further loss of U.S. shipbuilding capability will negatively impact the industrial base. As yards close, skilled labor will find work elsewhere and suppliers will leave the business, reducing sources of supply for the remaining shipyards.

Despite the projected loss of Navy business, U.S. shipyards have several opportunities which can alleviate the impact of declining Navy work. First, predictions for worldwide replacement tonnage are optimistic. Second, the new double hull tanker requirements will generate Jones Act business. Third, Desert Shield and Desert Storm demonstrated once again the importance of sealift and provided the impetus to get the sealift "ball" rolling. Fourth, closer trade ties under GATT will slowly weaken the subsidy advantage of European shipyards as will continued subsidy reductions called for by the EC's Seventh Directive. Finally, potential foreign military sales offer another avenue for relief.

C. RECOMMENDATIONS

Since one of the government's primary responsibilities is national defense, the government should determine the shipyard capability required to meet national security needs and examine how to best maintain that level. Such a study would be similar to the SYMBA and NADES studies. Reducing, maintaining, or increasing existing shipbuilding capability will depend on the results of such a study.

Reductions in capability would not necessarily be a goal. If commercial work could support a shipbuilding capability in excess of defensive needs, this would be the preferred alternative, providing government financing would not be required.

Maintaining or increasing existing capability would be a much harder task. Given the present state of the federal budget and the lack of commercial orders in U.S. yards, it would be extremely difficult to attract the thirty merchant builds per year to maintain the current shipyard base. It would be even more difficult to expand present shipbuilding capability without a tremendous amount of federal support.

As has been the case over the centuries, wild oscillations in shipbuilding capacity are expected to continue in the future. It is the industry's nature to expand and contract to meet the trade and the military requirements of the world's nations. The strongest shipyards will survive the future downturns. The weak ones may not. Shipbuilding is not a business for the weak at heart.

APPENDIX A.
SHIPS CONSTRUCTED IN THE UNITED STATES (1949 - 1958)

YEAR	NUMBER	GROSS TONS (000s)	DEADWEIGHT TONS (000s)
1949	33	540	857
1950	24	381	615
1951	10	147	182
1952	16	239	300
1953	37	493	752
1954	36	548	868
1955	7	94	131
1956	7	98	159
1957	11	236	373
1958	25	794	794
Rounded Total	206	3,300	5,031

[Ref. 71:p. 54]

APPENDIX B.
NAVY'S SHIPBUILDING PLAN FY 1992 - FY 1997
PLUS FY-91 APPROPRIATION
PRESIDENT'S BUDGET (SUBMITTED 2/4/91)

New Construction	FY-91	FY-92	FY-93	FY-94	FY-95	FY-96	FY-97	TOTAL
Trident	1	-	-	-	-	-	-	1
CVN	-	-	-	-	1	-	-	1
SSN-21	1	1	1	1	1	2	1	8
DDG-51	4	5	4	3	3	4	3	26
LHD-1	1	-	-	-	-	-	-	1
LX	-	-	-	-	1	-	1	2
LSD-41	1	1	1	-	-	-	-	3
MHC	2	2	2	1	-	-	-	7
MHC(V)	-	-	-	-	1	-	2	3
AR(X)	-	-	-	-	-	1	-	1
TAGOS	-	-	1	1	2	-	-	4
ARS	-	-	-	1	-	2	-	3
AOE	-	1	-	-	-	-	-	1
TAGS (OCEAN)	-	2	2	2	1	-	-	7
LCAC	(12)	(12)	-	-	-	-	-	(24)
TOTAL	10	12	11	9	10	9	7	68

[Ref. 57:p. 52]

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